Central Radio Propagation Laboratory

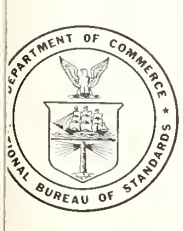
IONOSPHERIC PREDICTIONS

for

December

1964

TB 11-499-21/TO 31-3-28



U. S. DEPARTMENT of COMMERCE
National Bureau of Standards
Number 21/Issued September 1964

U.S. DEPARTMENT OF COMMERCE
Luther H. Hodges, Secretary

NATIONAL BUREAU OF STANDARDS
A. V. Astin, Director

Central Radio Propagation Laboratory

Ionospheric Predictions

for December 1964

Number 21
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September 1964

[Formerly "Basic Radio Propagation Predictions," CRPL Series D.]

The CRPL Ionospheric Predictions are issued monthly as an aid in determining the best sky-wave frequencies over any transmission path, at any time of day, for average conditions for the month. Issued three months in advance, each issue provides tables of numerical coefficients that define the functions describing the predicted worldwide distribution of foF2 and M(3000)F2 and maps for each even hour of universal time of MUF(Zero)F2 and MUF(4000)F2.

NOTE: Department of Defense personnel see back cover.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget (June 19, 1961).

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Annual subscription (12 issues) $1.50 (50 cents additional for foreign mailing).

National Bureau of Standards

The functions of the National Bureau of Standards are set forth in an Act of Congress, March 3, 1901, as amended. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to government agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. The Bureau also serves as the Federal technical research center in a number of specialized fields.

Central Radio Propagation Laboratory

The Central Radio Propagation Laboratory at Boulder, Colorado, is the central agency of the Federal Government for the collection, analysis, and dissemination of information on propagation of radio waves at all frequencies along the surface of the earth, in the atmosphere, and in space, and performs scientific studies looking toward new techniques for the efficient use and conservation of the radio spectrum. To carry out this responsibility, the CRPL—

1. Acts as the central agency for the conduct of basic research on the nature of radio waves, the pertinent properties of the media through which radio waves are transmitted, the interaction of radio waves with those media, and on the nature of radio noise and interference effects. This includes compilation of reports by other foreign and domestic agencies conducting research in this field and furnishing advice to government and nongovernment groups conducting propagation research.

2. Performs studies of specific radio propagation mechanisms and performs scientific studies looking toward the development of techniques for efficient use and conservation of the radiofrequency spectrum as part of its regular program or as requested by other government agencies. In an advisory capacity, coordinates studies in this area undertaken by other government agencies.

3. Furnishes advisory and consultative service on radio wave propagation, on radiofrequency utilization, and on radio systems problems to other organizations within the United States, public and private.

4. Prepares and issues predictions of radio wave propagation and noise conditions and warnings of disturbances in these conditions.

5. Acts as a central repository for data, reports, and information in the field of radio wave propagation.

6. Performs scientific liaison and exchanges data and information with other countries to advance knowledge of radio wave propagation and interference phenomena and spectrum conservation techniques, including that liaison required by international responsibilities and agreements.

Introduction

The "Central Radio Propagation Laboratory Ionospheric Predictions" is the successor to the former "Basic Radio Propagation Predictions," CRPL Series D. To make effective use of these predictions, National Bureau of Standards Handbook 90, "Handbook for CRPL Ionospheric Predictions Based on Numerical Methods of Mapping," should be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402, price 40 cents. This Handbook includes required additional data, nomographs and graphical aids, as well as methods for the use of the predictions. The Handbook supersedes the obsolete NBS Circular 465.

The basic prediction appears in tables 1 and 2, presenting predicted coefficients for foF2 and M(3000)F2 defining the numerical map functions describing the predicted worldwide variation of these characteristics. With additional auxiliary information, these coefficients may be used as input data for electronic computer programs solving specific high frequency propagation problems. The basic equations, their interpretation, and methods of using the numerical maps are described in two papers by W. B. Jones and R. M. Gallet, "The Representation of Diurnal and Geographic Variations of Ionospheric Data by Numerical Methods," Volume 66D, Number 4, July–August 1962, pages 419–438, and "Methods for Applying Numerical Maps of Ionospheric Characteristics," Volume 66D, Number 6, November–December 1962, pages 649–662, both in the Journal of Research of the National Bureau of Standards, Section D. Radio Propagation. The predicted numerical map coefficients of tables 1 and 2 may be purchased in the form of a tested set of punched cards. Write to the Prediction Services Section, Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado, to arrange for the purchase of the set of punched cards and for further information and assistance in the application of computer methods and numerical prediction maps to specific propagation problems.

The graphical prediction maps, derived from the basic prediction, are provided for those unable to make use of an electronic computer. Figures 1 to 12 present world maps of MUF (Zero) F2 and MUF(4000)F2 for each even hour of universal time. Figures 13 to 16 present the same predictions for hours 00 and 12 universal time for the North and South Polar areas. Predicted polar maps for each even hour of universal time may be obtained by special arrangements with the Central Radio Propagation Laboratory. Handbook 90 describes methods for including regular E–F1 propagation. Figure A is a graph of predicted and observed Zürich sunspot numbers which shows the recent trend of solar activity. Table A lists observed and predicted Zürich smoothed relative sunspot numbers and includes the sunpot number used for the current prediction.

Members of the U.S. Army, Navy, or Air Force desiring the Handbook and the Ionospheric Predictions should send requests to the proper service address; for the Navy: The Director, Naval Communications, Department of the Navy, Washington, D.C., 20350; for the Air Force: Directorate of Command Control and Communications, Headquarters, United States Air Force, Washington, D.C., 20330. Attention: AFOCCAA. Army personnel should refer to the Handbook as TM-11–499 and to the monthly predictions as TB 11–499–( ), predictions for the month of December 1964 being distributed in September 1964 and designated TB 11–499–(21), and should requisition these through normal publication channels.

Information concerning the theory of radio wave propagation and such important problems as absorption, field intensity, lowest useful high frequencies, etc., is given in National Bureau of Standards Circular 462, "Ionospheric Radio Propagation." A revised work is in preparation which will be announced in the Ionospheric Prediction series when available. Additional information about radio noise may be found in C.C.I.R. Report Number 65, "Revision of Atmospheric Noise Data," International Telecommunication Union, Geneva, 1957.

Reports to this Laboratory of experience with these predictions would be appreciated. Correspondence should be addressed to the Prediction Services Section, Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado.

NOTE: The MUF(ZERO)F2 values of figures 1A through 12A were derived by adding one-half the gyrofrequency to the foF2 calculated by use of the predicted coefficients in table 1. The error introduced by this approximation is generally not important compared to other uncertainties in the predictions, and is significant only when the foF2 is near or below the gyrofrequency. If more precise values of predicted fxF2 are desired, the theoretical relationships should be applied to the foF2 values calculated by the coefficients in table 1.

Table A

Observed and Predicted Zurich Smoothed Relative Sunspot Numbers

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1952	43	42	39	36	34	32	31	29	28	28	27	26
	(53)	(51)	(52)	(52)	(52)	(52)	(51)	(49)	(46)	(43)	(38)	(33)
1953	24	22	20	19	17	15	13	12	11	10	9	7
	(30)	(29)	(27)	(24)	(22)	(21)	(20)	(18)	(18)	(17)	(16)	(15)
1954	6	6	4	3	4	4	5	7	8	8	10	12
	(14)	(12)	(11)	(10)	(10)	(9)	(8)	(8)	(8)	(10)	(10)	(11)
1955	14	16	20	23	29	35	40	46	55	64	73	81
	(12)	(14)	(14)	(13)	(16)	(18)	(22)	(27)	(30)	(31)	(35)	(42)
1956	89	98	109	119	127	137	146	150	151	156	160	164
	(48)	(53)	(60)	(68)	(77)	(89)	(95)	(105)	(119)	(135)	(147)	(150)
1957	170	172	174	181	186	188	191	194	197	200	201	200
	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)
1958	199	201	201	197	191	187	185	185	184	182	181	180
	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)
1959	179	177	174	169	165	161	156	151	146	141	137	132
	(150)	(150)	(150)	(150)	(146)	(143)	(141)	(142)	(141)	(139)	(137)	(137)
1960	129	125	122	120	117	114	109	102	98	93	88	84
	(136)	(135)	(133)	(130)	(125)	(120)	(118)	(115)	(110)	(108)	(105)	(100)
1961	80	75	69	64	60	56	53	52	52	51	50	49
	(100)	(90)	(90)	(90)	(85)	(85)	(80)	(75)	(70)	(70)	(65)	(60)
1962	45	42	40	39	39	38	37	35	33	31	30	30
	(60)	(50)	(48)	(45)	(42)	(37)	(34)	(31)	(29)	(28)	(27)	(34)
1963	29	30	30	29	29	28	28	27	27	26	23	21
	(31)	(28)	(26)	(25)	(25)	(25)	(23)	(21)	(20)	(18)	(18)	(17)
1964												
	(17)	(17)	(17)	(17)	(17)	(17)	(17)	(17)	(17.5)	(17.3)	(17.0)	(17.0)

Note: Final numbers are listed through June 1963, the succeeding values being based on provisional data. The predicted numbers are in parentheses.

* Number used for predictions in this issue.

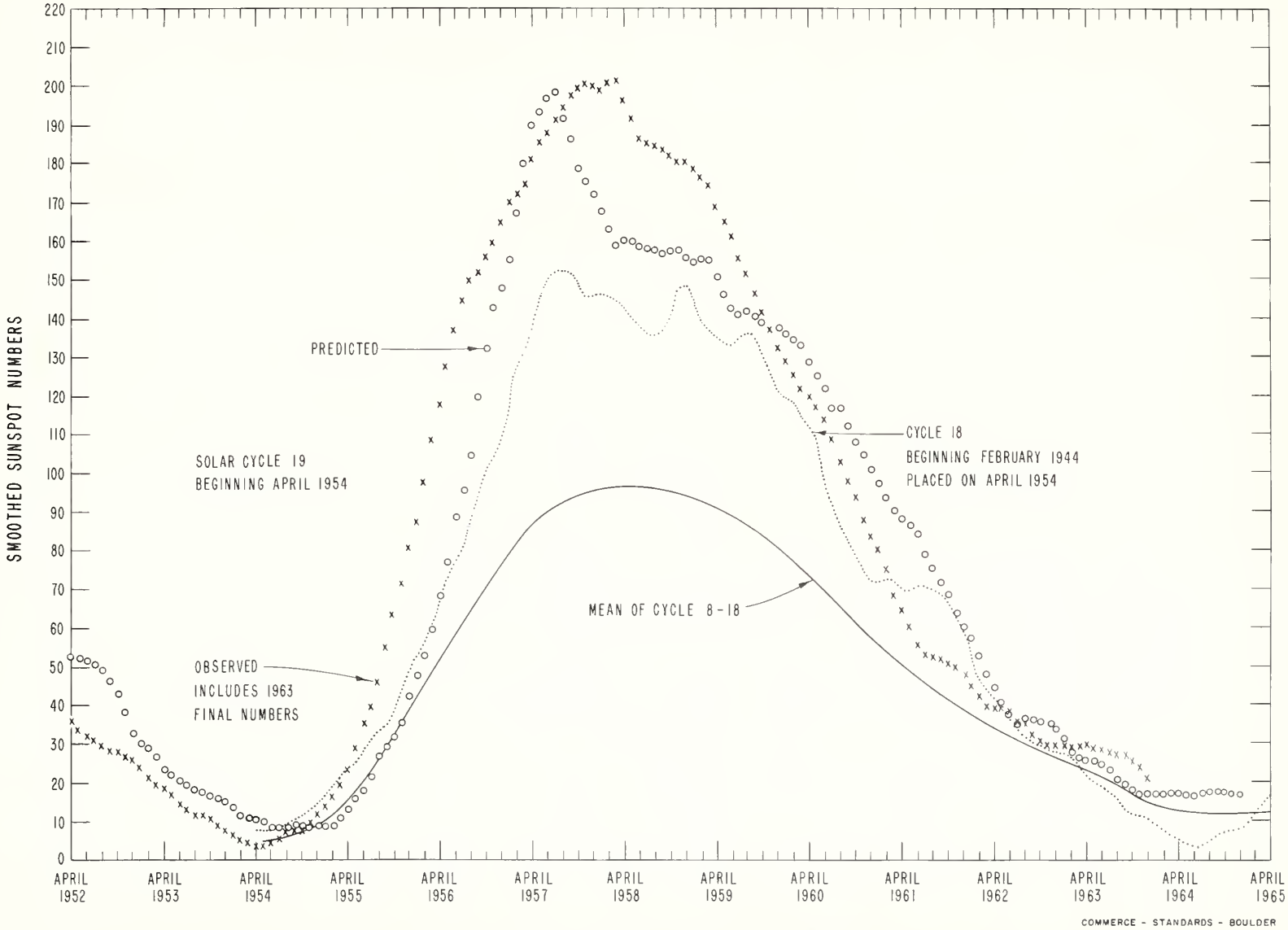

FIG. A. PREDICTED AND OBSERVED SUNSPOT NUMBERS

TABLE I

TIME VARIATION

GEOGRAPHICAL VARIATION

Harmonic		0	1		2		3		4	
	K \ S	0	1	2	3	4	5	6	7	8
I	0	6.5939321E 00	1.8225745E 00	1.9578359E 00	-6.5832752E-01	1.4065070E-01	-1.3229910E-01	-4.1582128E-01	1.8923635E-01	-1.6659020E-01
	1	-2.4861956E 00	-1.3668815E 00	5.0464315E-01	-6.5133533E-01	-5.6980441E-01	-1.3810913E 00	-1.4748438E 00	1.6486156E-01	-2.7630032E-01
	2	2.5935473E 00	1.4448607E 00	7.4746584E 00	5.5928280E 00	8.2184262E 00	-1.2162754E 00	-1.1907195E 00	-2.5301954E-01	2.2028974E-01
	3	1.2196110E 01	1.6096838E 01	1.9531052E 01	8.5041536E 00	1.8609960E 01	1.0403469E 01	1.6172216E 01	-9.4820751E-01	-3.3205548E 00
	4	-7.5240872E 01	-6.7314246E 01	-5.6347106E 01	-8.4600908E 00	-4.5499951E 01	1.7754290E 01	1.7730452E 01	-1.7222656E 00	-2.8403915E 00
	5	-6.6600443E 01	-9.2555008E 01	-1.3551303E 02	-3.4881045E 01	-1.0497709E 02	-3.2417440E 01	-6.4845813E 01	1.1553742E 00	2.3057002E 01
	6	2.8153719E 02	2.5530321E 02	1.0535572E 02	-4.0018039E 01	1.0011572E 02	-7.3384143E 01	-5.7834455E 01	8.9727856E 00	1.6787249E 01
	7	1.7285038E 02	2.1953137E 02	3.3931504E 02	7.0447652E 01	2.4302805E 02	4.5412800E 01	1.2015816E 02	-2.6630825E 00	-5.6190784E 01
	8	-4.5718226E 02	-3.9670927E 02	-2.5318477E 01	1.3840498E 02	-9.6018414E 01	1.3268425E 02	8.4031583E 01	-2.4785927E 01	-3.9603840E 01
	9	-1.9894590E 02	-2.2384300E 02	-3.6001061E 02	-6.6226725E 01	-2.4374394E 02	-2.7238864E 01	-1.0279380E 02	5.1994704E 00	5.9721523E 01
	10	3.3740355E 02	2.7651601E 02	-9.1672149E 01	-1.4723636E 02	3.3784315E 01	-1.0942720E 02	-5.5005155E 01	3.1277501E 01	4.1363432E 01
	11	8.2728541E 01	8.2287381E 01	1.3641557E 02	2.2891559E 01	8.7812597E 01	5.2344254E 00	3.2864770E 01	-2.8851500E 00	-2.2999876E 01
	12	-9.1573831E 01	-7.0653170E 01	5.9099361E 01	5.2367730E 01	-7.3825861E-01	3.3806921E 01	1.2699980E 01	-1.3681857E 01	-1.5757525E 01
II	13	-2.9677138E-02	-1.1041123E-01	-1.9373887E-02	9.3236012E-03	1.7346255E-01	7.2930449E-02	9.6250322E-02	-8.5925542E-02	-1.3048451E-02
	14	-1.7278191E-01	2.6937250E-02	-2.2960156E-01	8.3067027E-02	-7.7790946E-02	1.4278768E-01	2.1977369E-01	-8.0282952E-02	-5.5984034E-02
	15	-1.3482728E 00	-1.9605499E 00	-8.9083160E-01	7.1095512E-01	4.4678450E-01	3.9675406E-01	3.1897501E-02	5.9408196E-01	1.0146357E-01
	16	-3.9141047E 00	-6.5203799E-01	-1.3968670E 00	-2.3718253E 00	-3.0443667E 00	-9.5346071E-01	-1.0795942E 00	1.0456132E 00	-4.3696431E-02
	17	4.5769683E-01	3.0059164E 00	-1.1595046E 01	-3.4145699E 00	-6.9971235E 00	-3.7656144E 00	-3.1633359E 00	4.2448779E 00	1.3167922E 00
	18	2.3671640E 01	1.3114349E 01	-6.1896252E 00	3.0912594E 00	6.8245545E 00	-5.8318460E-01	-3.5686605E 00	2.5507015E 00	2.5681762E 00
	19	4.8448248E 01	3.9311684E 01	6.1502212E 00	-6.1681924E 00	6.3479848E-01	-4.3461061E 00	-3.6531419E 00	-1.2362387E 01	-1.4235264E 00
	20	8.8136451E 01	4.4235858E 01	4.2872254E 01	3.0288042E 01	3.5267066E 01	9.8131421E 00	1.5628147E 01	-1.5298522E 01	4.6823943E-01
	21	2.8648045E 00	7.3554636E 00	1.2739702E 02	2.0418096E 01	5.1412712E 01	2.1189010E 01	2.5240871E 01	-4.2015715E 01	-4.7055905E 00
	22	-2.8149343E 02	-1.6274088E 02	1.0708837E 02	-5.8247612E 01	-8.3835500E 01	-1.8622696E 01	2.1574771E 01	-1.9516629E 01	-2.6639401E 01
	23	-3.0172514E 02	-2.2420200E 02	-3.2441963E 01	8.7503003E 00	-2.0321934E 01	1.2540032E 01	2.6730535E 01	6.5147462E 01	9.9489005E 00
	24	-4.5930442E 02	-2.5476553E 02	-2.1459617E 02	-1.2718774E 02	-1.3278595E 02	-3.3699170E 01	-7.3858653E 01	7.7801369E 01	-2.7227761E 00
	25	-1.7610449E 01	-1.3668742E 02	-4.9275470E 02	-1.8122023E 01	-1.5056676E 02	-2.8189444E 01	-7.8158823E 01	1.6552364E 02	-5.5397301E 00
	26	1.1450951E 03	7.0664373E 02	-5.1906369E 02	2.9005483E 02	3.5720626E 02	1.2349111E 02	-5.8493080E 01	6.6130714E 01	1.1982657E 02
	27	7.1835909E 02	5.2980366E 02	7.4179040E 01	1.6825408E 01	5.8826486E 01	-1.5207067E 01	-7.1428410E 01	-1.4258019E 02	-3.1274630E 01
	28	1.0113713E 03	5.4598736E 02	4.0644221E 02	2.3189834E 02	2.2336930E 02	5.3384133E 01	1.5204317E 02	-1.7017327E 02	4.4384760E 00
	29	3.8537489E 01	4.2344636E 02	8.7953370E 02	-6.5492660E 01	2.0487172E 02	-3.3539523E 01	1.0795120E 02	-3.0737580E 02	3.9354220E 01
	30	-2.1439317E 03	-1.4249316E 03	1.0378318E 03	-6.2863556E 02	-7.0592780E 02	-2.8280814E 02	8.1700013E 01	-1.1333478E 02	-2.5421670E 02
	31	-7.4618243E 02	-5.5048377E 02	-6.9239883E 01	-4.2481762E 01	-6.2633237E 01	1.0307338E 01	8.1456795E 01	1.4049020E 02	4.1672084E 01
	32	-9.9077793E 02	-5.0529458E 02	-3.3082273E 02	-1.9095203E 02	-1.7034533E 02	-4.3303960E 01	-1.4310905E 02	1.6566595E 02	-1.6964402E 00
	33	-3.2930265E 01	-5.0752513E 02	-7.4032052E 02	1.2990997E 02	-1.2551855E 02	9.1177787E 01	-6.4624121E 01	2.7191950E 02	-5.1461905E 01
	34	1.8836950E 03	1.3518137E 03	-9.0617224E 02	6.2375661E 02	6.5689472E 02	2.7532145E 02	-5.9156673E 01	9.4987499E 01	2.4869507E 02
	35	2.8303552E 02	2.0873862E 02	2.1891585E 01	2.1985109E 01	2.2669715E 01	-4.0711200E 00	-3.3245744E 01	-5.1689539E 01	-1.9474990E 01
	36	3.5382399E 02	1.6978747E 02	9.6157515E 01	5.8230636E 01	4.7862993E 01	1.5262126E 01	5.0536596E 01	-5.8921284E 01	-3.1392460E-01
	37	8.8538352E 00	2.1233273E 02	2.3656217E 02	-6.3579802E 01	2.6181498E 01	-4.7231675E 01	1.2341132E 01	-9.2743313E 01	2.1011440E 01
	38	-6.2952409E 02	-4.8670911E 02	2.8540755E 02	-2.3099191E 02	-2.3105681E 02	-9.6715363E 01	1.8218216E 01	-3.0601192E 01	-9.0315034E 01
III	39	1.6461004E-01	2.7916180E-02	-2.6514159E-01	9.9110409E-03	-5.5022627E-02	1.7714125E-02	-5.3697280E-03	-2.1774078E-02	-8.8503734E-03
	40	3.1277670E-03	2.3551440E-01	1.2383409E-02	-1.0083207E-02	2.4841474E-02	2.1301597E-02	7.6008078E-02	-3.4210715E-03	-7.6776749E-03
	41	7.1134806E-02	1.3039709E 00	1.1545002E-01	-3.2979442E-01	-4.3060215E-01	-6.1487731E-01	-1.3602870E-01	1.8634559E-01	-6.7408849E-02
	42	6.4618740E-02	2.8910372E-01	-3.8687288E-01	3.4196006E-01	1.6925094E-01	1.9215473E-01	-2.6121559E-01	1.6343308E-01	-2.1231094E-03
	43	2.4686083E-01	3.2945956E 00	4.9801941E 00	-4.5919453E-01	2.5734443E 00	-1.3765534E-01	-1.0131909E-01	5.1476336E-01	-2.6571450E-03
	44	-1.3006565E-02	-1.3241535E 00	2.5943063E 00	5.3612049E-05	-3.0425029E-01	5.9334365E-02	-2.2602406E-01	6.5032818E-02	1.9293860E-02
	45	-3.0787697E-01	-4.6508219E 00	-2.4417396E-01	6.5956730E-01	2.3285113E 00	3.1106281E 00	3.4463426E-01	-4.0686820E-01	-1.0017933E-03
	46	-3.3051943E-01	-7.7397711E-01	3.9027258E 00	-8.0305042E-01	-6.5942765E-01	-3.3388332E-01	4.7573947E-01	-2.8113947E-01	8.8122134E-03
	47	-8.0000027E-01	-1.3214107E 01	-1.7507269E 01	1.1057055E-01	-7.8565543E 00	5.5145776E-02		-7.7163092E-01	7.4582014E-04
	48	-5.4473337E-02	1.3102747E 00	-1.3073772E 01	9.4727796E-02	1.9542649E-01	-2.2279002E-01			-2.6125127E-02
	49	2.8977817E-01	3.2115788E 00	-2.5912365E-02	3.7550723E-02	-2.0138845E 00	-3.2104144E 00			
	50	3.6540290E-01	1.6477515E-01	-6.0606560E 00	1.3226858E-01	9.2699350E-01	1.6948322E-02			
	51	6.0790687E-01	1.2161844E 01	1.5423578E 01		6.3414584E 00	8.2768663E-02			
	52			1.4349116E 01			2.5717940E-01			

GEOGRAPHICAL VARIATION

Harmonic		5		6		7		8	
	K \ S	9	10	11	12	13	14	15	16
I	0	8.2394387E-02	2.1338485E-01	-5.7763303E-02	-1.5178883E-02	-4.1200479E-02	-8.2990277E-02	7.0917054E-02	-1.6916163E-02
	1	1.8124202E-01	-7.2370486E-02	6.1213997E-02	2.0516050E-01	-4.6501896E-02	3.8146612E-02	-4.1466952E-02	-8.5722581E-02
	2	-3.1908808E-01	-8.1275983E-01	2.3352992E-01	1.8907994E-01	1.5448604E-01	3.3013640E-01	-3.2572570E-01	2.7424783E-02
	3	-2.0567619E-01	6.3872671E-02	-6.8348936E-02	-2.4662022E-01	6.7185670E-02	-3.5529399E-02	4.9262649E-02	1.0699979E-01
	4	2.3600399E-01	6.1633186E-01	-1.7310897E-01	-2.0817979E-01	-1.1022621E-01	-2.5831929E-01	2.7838033E-01	-2.8210060E-03

I - Main latitudinal variation. Mixed latitudinal and longitudinal variation: II - First order in longitude, III - Second order in longitude

Notation: For each entry the number given by the first eight digits and sign is multiplied by the power of ten defined by the last two digits and sign.

PREDICTED COEFFICIENTS D_{SK} DEFINING THE FUNCTION $\Gamma(\lambda,\theta,t)$ FOR MONTHLY MEDIAN f_o F2 (Mc/s)

DECEMBER 1964

TABLE I

TIME VARIATION

TABLE 2

TIME VARIATION

Harmonic		0	1		2		3	
	S / K	0	1	2	3	4	5	6
GEOGRAPHICAL VARIATION I	0	2.9907983E 00	-9.9436333E-02	-2.6064568E-01	3.3980967E-02	-9.1976889E-02	3.9967059E-02	-2.4825942E-02
	1	4.9437196E-01	1.4059814E-01	2.0444930E-02	1.3294449E-02	-5.9235837E-03	-2.8245941E-01	-3.5772433E-02
	2	1.9235049E 00	9.8427118E-01	2.2866386E 00	1.5683553E-01	-6.0266898E-02	-7.3674822E-01	-3.3504204E-01
	3	-7.1000417E-01	-7.6766841E-01	1.2059490E 00	-3.6347121E-01	-2.7224339E-02	1.2390203E 00	2.0258305E-02
	4	-5.6848781E 00	-2.5684893E 00	-4.3865394E 00	-1.1499381E 00	6.3073468E-01	2.5137736E 00	1.4680460E 00
	5	1.5406171E-01	1.4290003E 00	-2.1787997E 00	7.3449917E-01	3.9194275E-01	-1.8321422E 00	6.2432126E-02
	6	6.1955078E 00	2.8635139E 00	3.2975185E 00	1.7710252E 00	-6.2287788E-01	-3.2270058E 00	-1.8500097E 00
	7	1.2699893E-01	-7.7871723E-01	1.0479692E 00	-3.7646503E-01	-3.1970307E-01	8.8033893E-01	-4.1771966E-02
	8	-2.3463257E 00	-1.1653255E 00	-8.9917302E-01	-8.0149919E-01	1.6293211E-01	1.4295591E 00	7.6265216E-01
II	9	-5.4306836E-03	-1.3339810E-02	2.7233768E-02	-1.5201424E-02	1.7919448E-02	7.4853107E-04	-7.5624312E-04
	10	-1.2500402E-01	-4.6379781E-02	-4.5309170E-02	-1.7636383E-02	1.1801973E-02	9.1042309E-02	8.9765214E-03
	11	1.0899830E-01	-1.3449299E-01	1.0198856E-01	3.6324521E-02	1.5804032E-01	5.1941195E-02	-4.3266073E-02
	12	-2.4879318E-01	-2.5876032E-01	-9.4941660E-01	4.3763064E-02	-8.9469522E-02	1.5861568E-01	8.6124773E-02
	13	-1.2053116E-01	-1.1130027E-01	-3.0797849E-01	1.7240971E-01	-1.1786614E-01	-5.0020590E-02	3.7464312E-01
	14	1.3244826E 00	7.7662913E-01	2.1997126E-01	2.6884388E-01	-2.8130924E-01	-1.5722579E 00	-1.0637405E-01
	15	-3.1634918E-01	8.1761240E-01	-2.9637765E-01	-4.1080421E-01	-8.2136256E-01	-3.4404475E-01	4.5775428E-02
	16	1.2338351E 00	1.7948560E 00	6.0490451E 00	5.7982444E-02	2.5777716E-01	-7.8651215E-01	-6.3187820E-01
	17	9.5968455E-01	1.3638264E 00	5.3733740E-01	-2.9047105E-01	-1.9118655E-01	3.2956489E-01	-1.7449834E 00
	18	-4.1279312E 00	-3.0911134E 00	4.6626702E-01	-2.1699523E 00	1.3745223E 00	6.8906762E 00	1.0548442E 00
	19	1.8327392E-01	-1.9289053E 00	5.6739507E-01	8.1466303E-01	1.4318811E 00	5.7116841E-01	2.5193036E-01
	20	-1.9895628E 00	-3.4656352E 00	-1.1204107E 01	-2.5162179E-01	-3.8332721E-01	1.2100925E 00	1.0423870E 00
	21	-1.9789157E 00	-3.0661088E 00	1.3350926E-01	7.3446670E-02	1.2431639E 00	-6.4908906E-01	2.3877973E 00
	22	4.9850870E 00	4.3937372E 00	-2.6062634E 00	4.3761554E 00	-2.4117808E 00	-1.0728842E 01	-2.2185594E 00
	23	1.7823818E-02	1.1771039E 00	-4.7519730E-01	-4.0835921E-01	-7.6437651E-01	-2.4032375E-01	-2.7187347E-01
	24	1.0338985E 00	2.0999289E 00	6.6101913E 00	1.6757894E-01	2.5461702E-01	-5.9545991E-01	-5.0445236E-01
	25	1.2196901E 00	1.9367501E 00	-2.3477801E-01	7.2538750E-02	-1.0356908E 00	3.8032662E-01	-9.9666462E-01
	26	-2.1683851E 00	-2.0493992E 00	2.0993062E 00	-2.4687634E 00	1.4223016E 00	5.4255953E 00	1.2963474E 00
III	27	-5.0627127E-02	-1.2293288E-02	-1.6814474E-02	1.2722240E-02	2.9990501E-03	2.1301978E-02	5.7692587E-03
	28	-3.0764014E-02	-1.9730802E-02	-1.9034817E-03	-5.9782153E-03	6.9619126E-03	6.9942040E-03	4.8379377E-03
	29	-1.0414192E-01	-4.6151049E-02	-9.4849795E-02	2.0999584E-02	-4.7125341E-02	3.7393427E-03	1.3259326E-02
	30	1.1341843E-01	-6.3420434E-02	-1.7943815E-02	2.7694315E-02	-8.7954609E-02	-1.3099115E-03	2.5171486E-02
	31	1.9509924E-01	1.2080710E-02	1.6716050E-01	-6.2541554E-03	-2.7603588E-02	-2.1013248E-01	-1.4103678E-01
	32	4.8400509E-02	1.2768343E-01	-3.5588334E-02	-2.0278560E-03	3.3867185E-04	-4.9305847E-02	5.8167825E-03
	33	2.5325946E-01	1.4103575E-01	2.6017449E-01	-3.0649798E-03	1.0357207E-01	6.5678446E-03	-3.5510569E-02
	34	-2.6536983E-01	1.9694053E-01	-2.0958042E-03	-1.6186185E-03	1.9911752E-01	-5.9396884E-02	-6.3840622E-02
	35			1.4412780E-02	7.3175458E-03	-4.0792634E-03	2.9614290E-01	2.0573429E-01
	36			1.0010777E-02		-7.4630462E-03		

Harmonic		4		5		6	
	S / K	7	8	9	10	11	12
GEOGRAPHICAL VARIATION I	0	-1.4550808E-03	-2.3550169E-03	1.7565526E-02	2.2735727E-02	-1.1018069E-02	-2.8038983E-03
	1	-2.6673493E-04	-1.0869473E-01	3.6696738E-02	2.7378740E-02	2.8008511E-03	3.2094335E-02
	2	-4.5498784E-03	2.0013205E-03	-2.7511974E-02	-4.2487069E-02	1.7241884E-02	1.2895037E-03
	3	-1.8749653E-03	1.1695788E-01	-4.3587174E-02	-3.9549705E-02		-3.5722442E-02

I - Main latitudinal variation. Mixed latitudinal and longitudinal variation: II - First order in longitude, III - Second order in longitude.

Notation: For each entry the number given by the first eight digits and sign is multiplied by the power of ten defined by the last two digits and sign.

PREDICTED COEFFICIENTS D_{SK} DEFINING THE FUNCTION $\Gamma(\lambda,\theta,t)$ FOR MONTHLY MEDIAN M(3000)F2

DECEMBER 1964

DECEMBER 1964 UT= 00

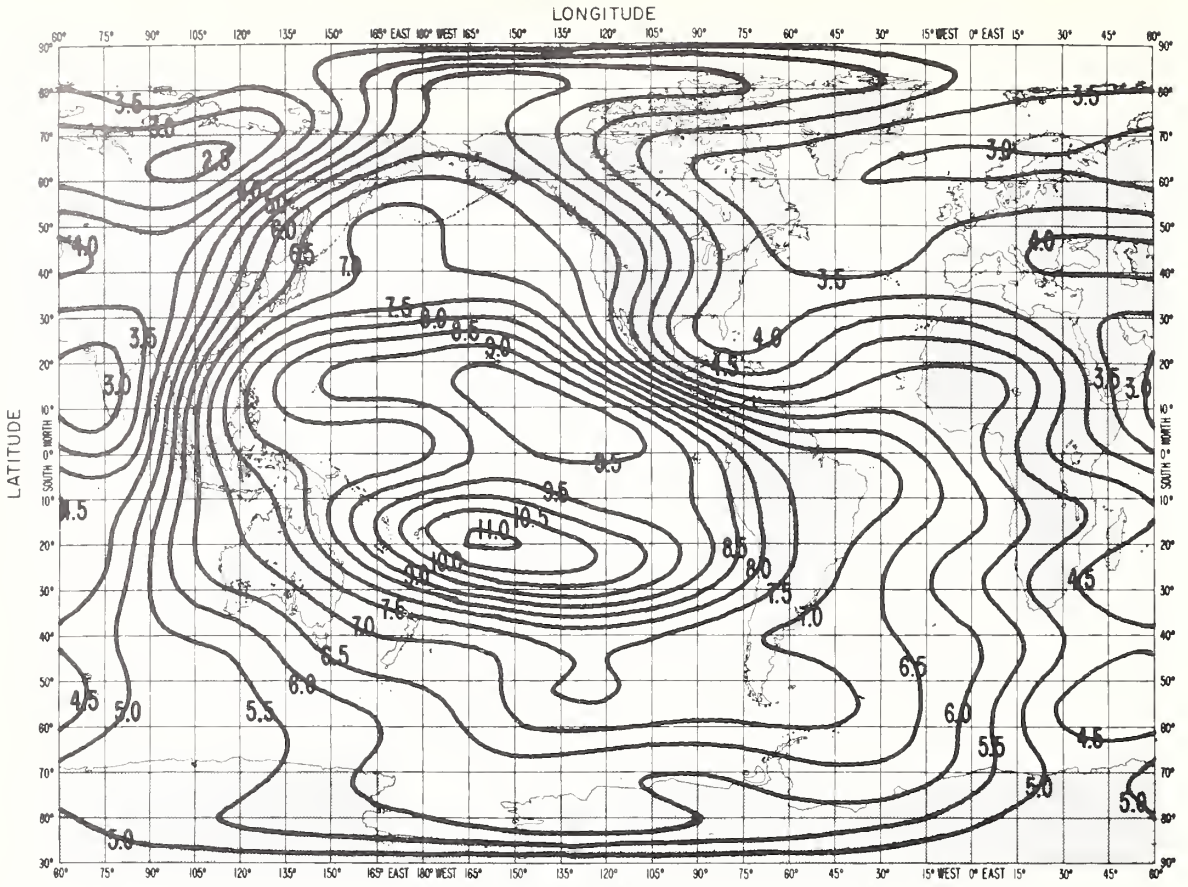

FIG. 1A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

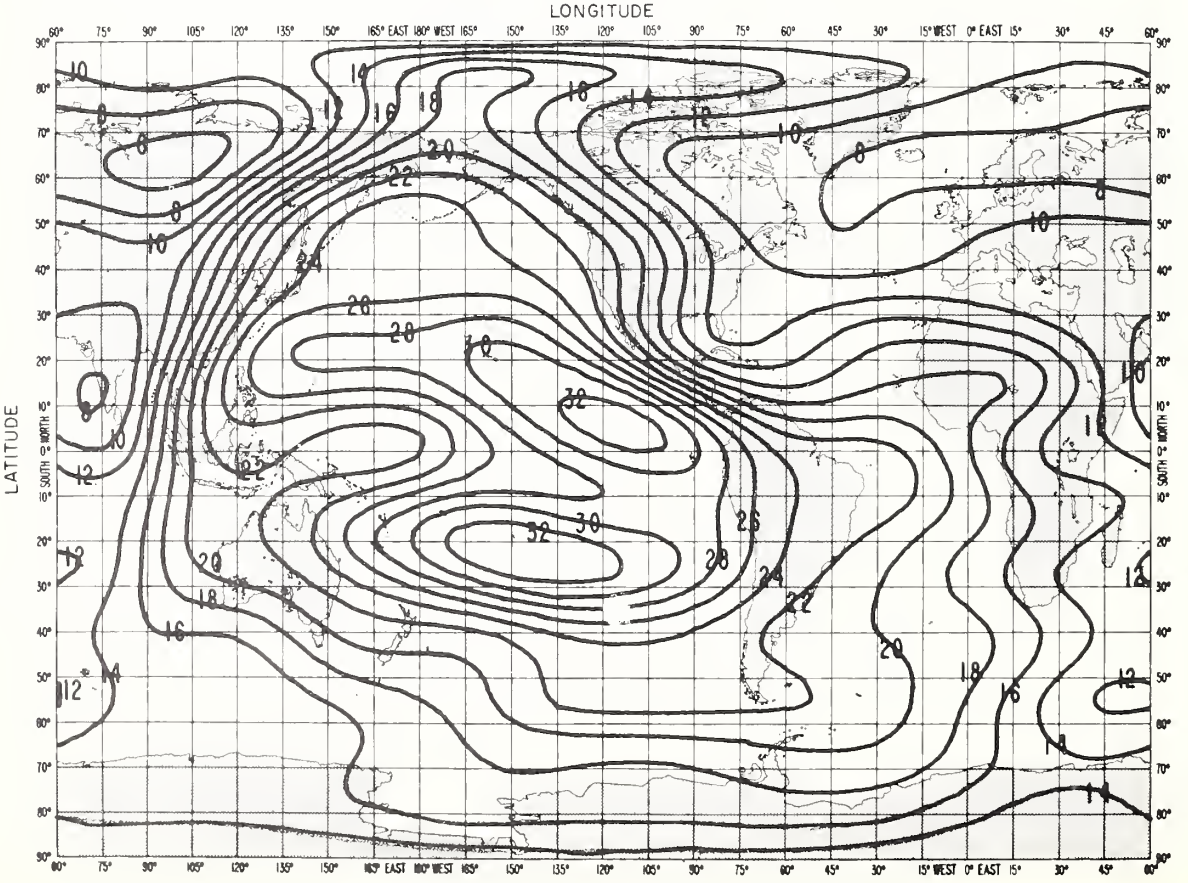

FIG. 1B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

DECEMBER 1964 UT= 02

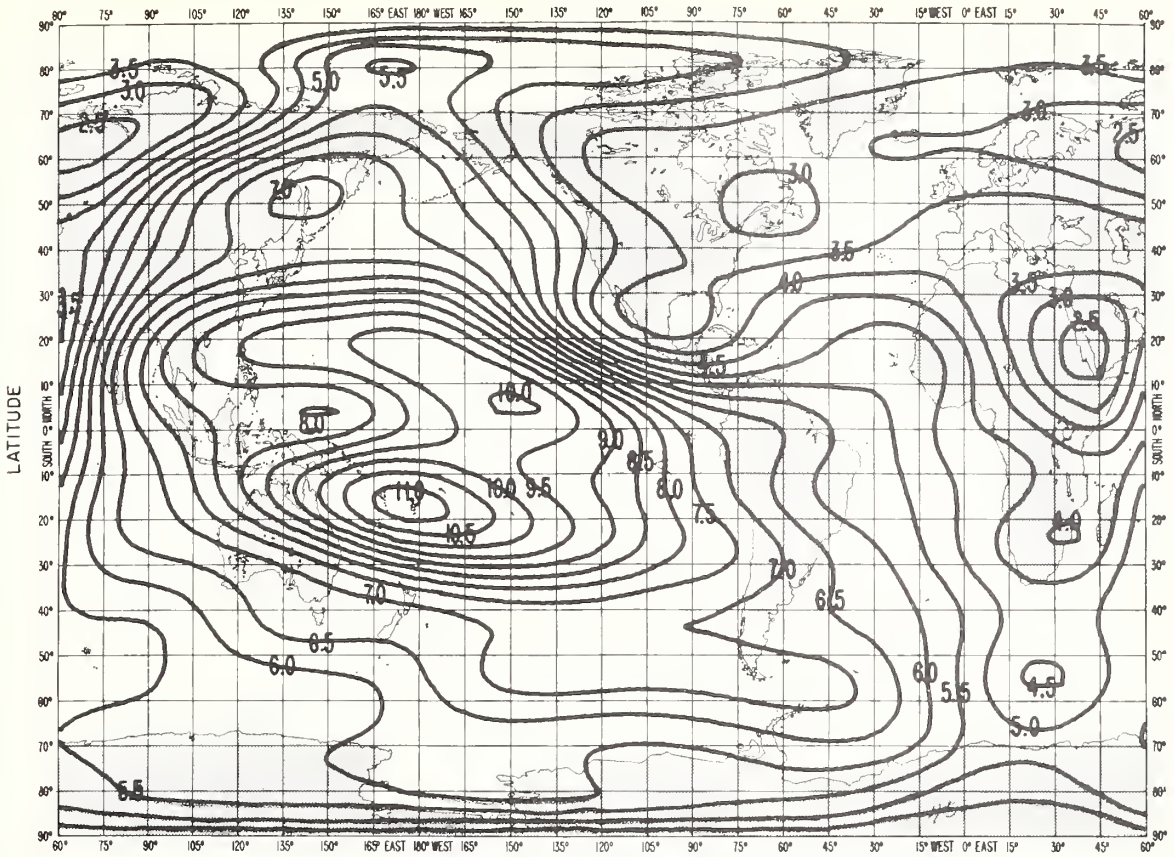

FIG. 2A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

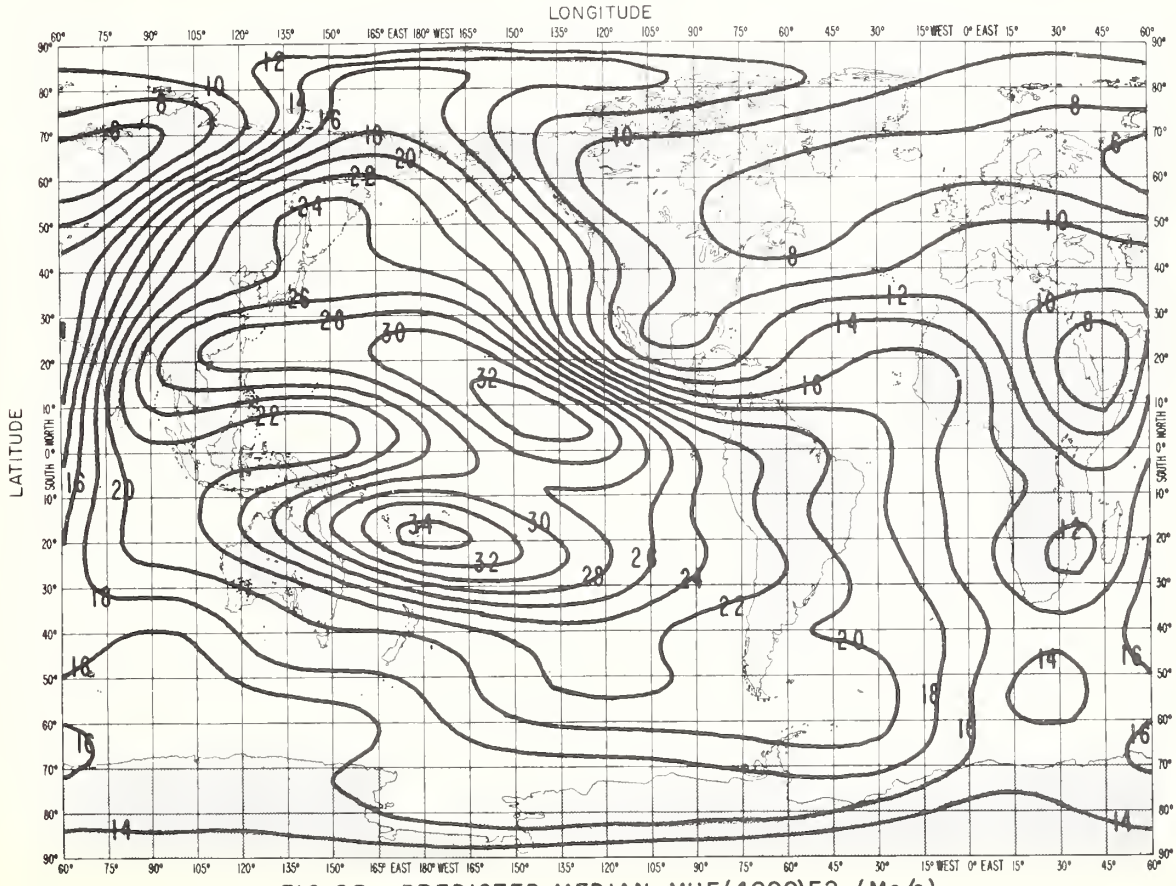

FIG. 2B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

DECEMBER 1964 UT=04

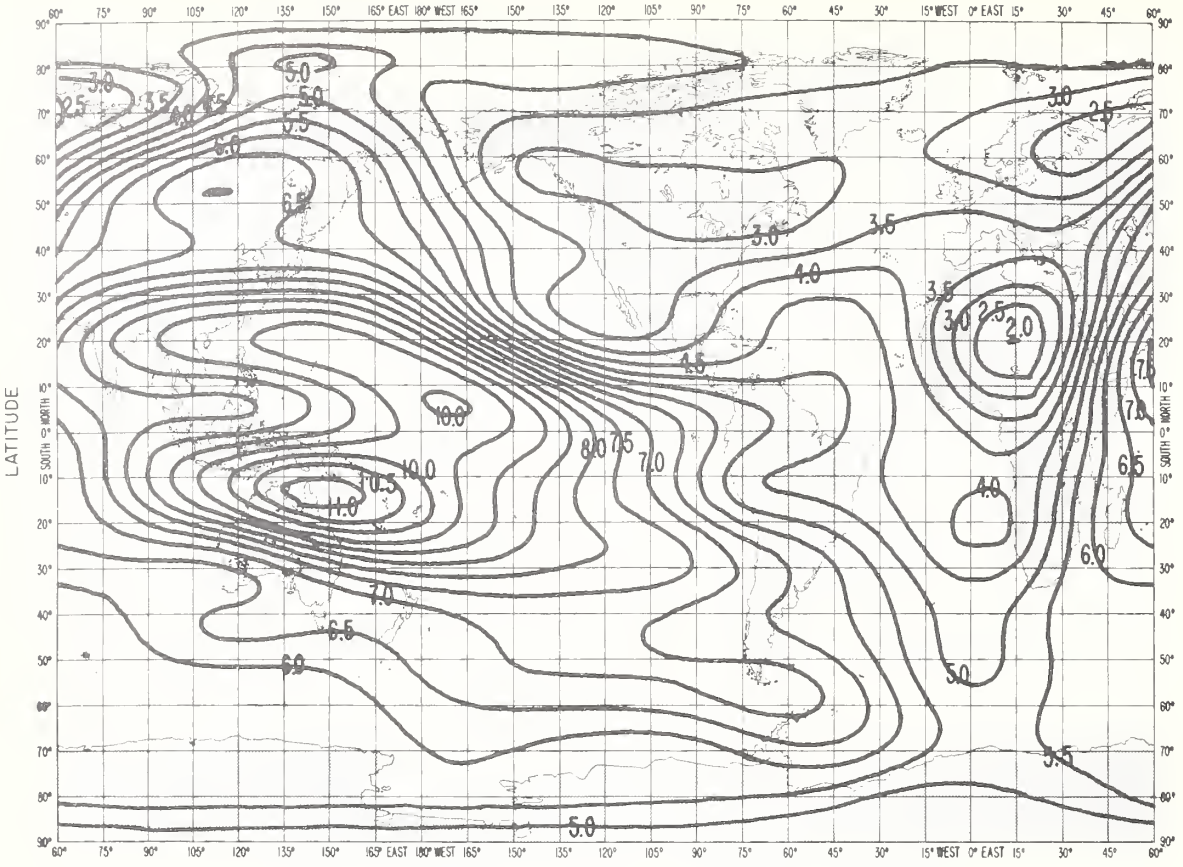

FIG. 3A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

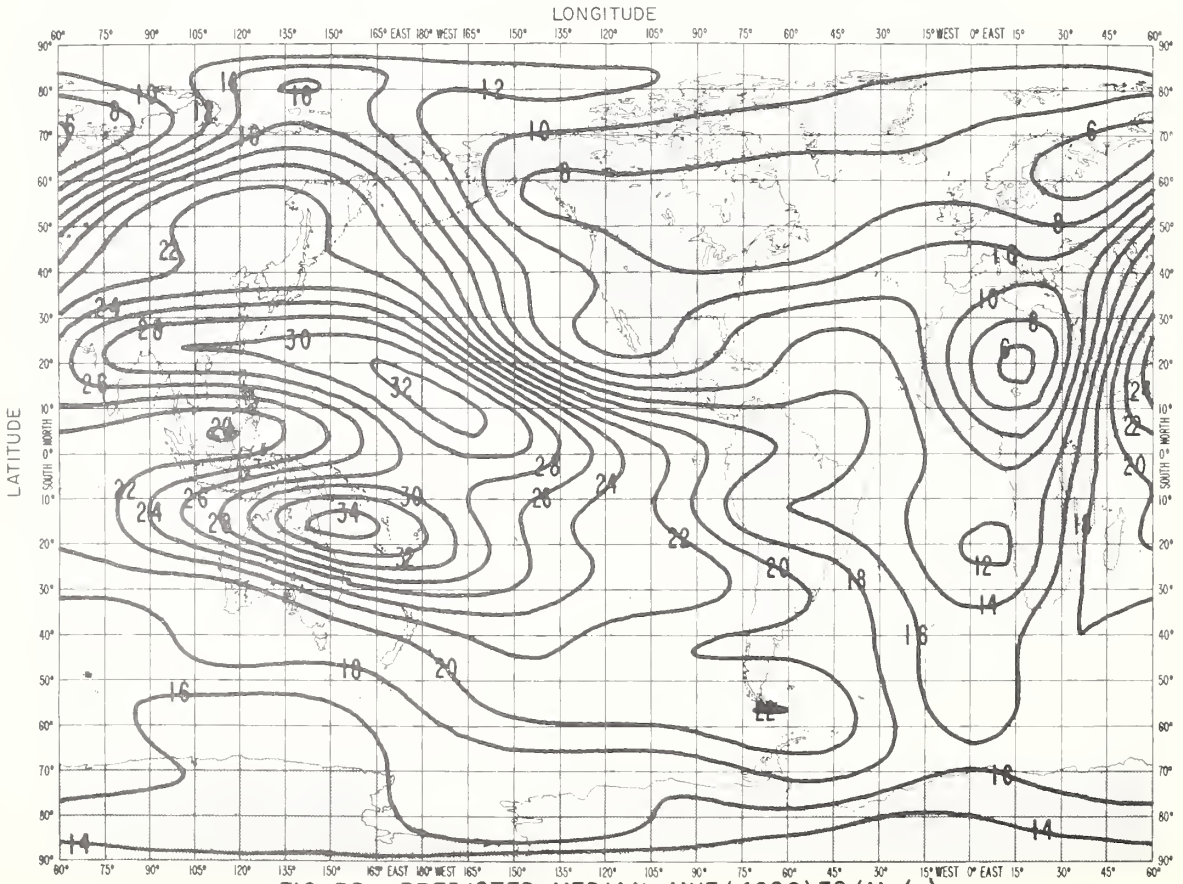

FIG. 3B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

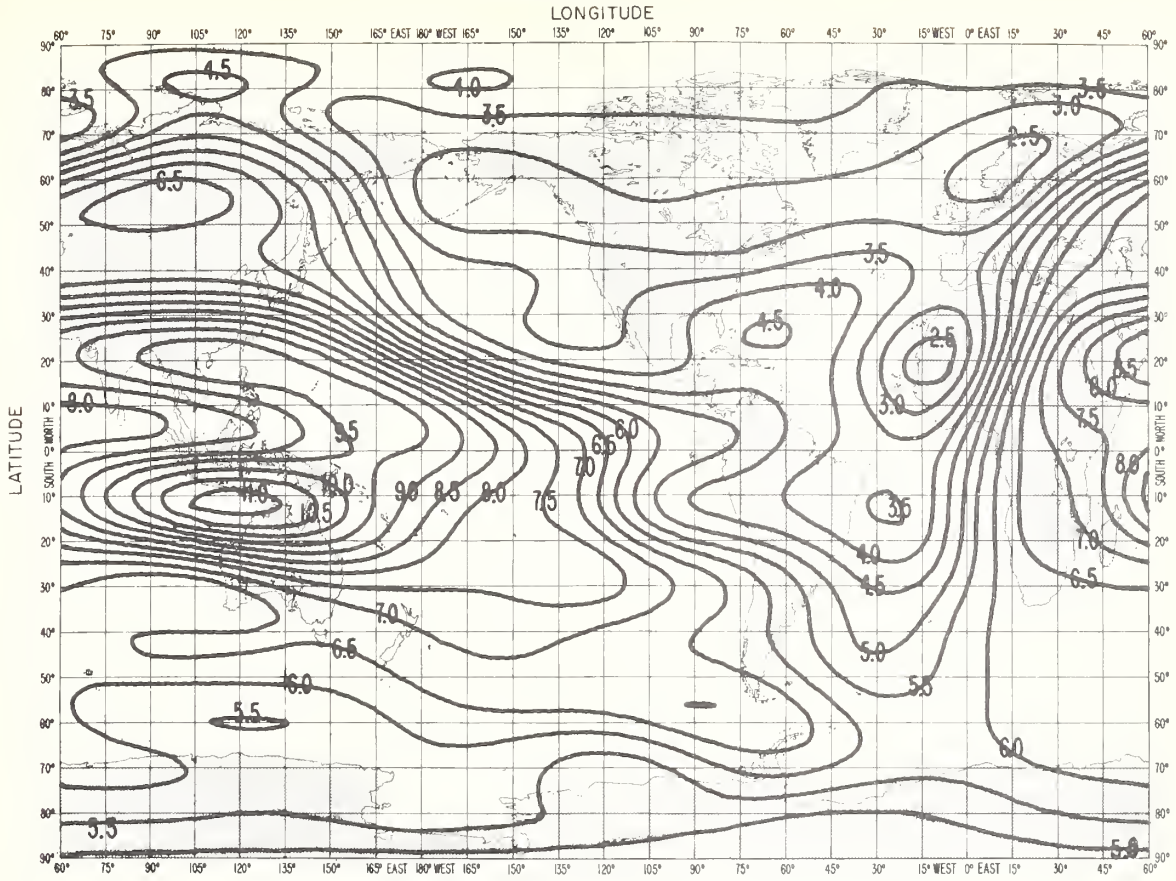

FIG. 4A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

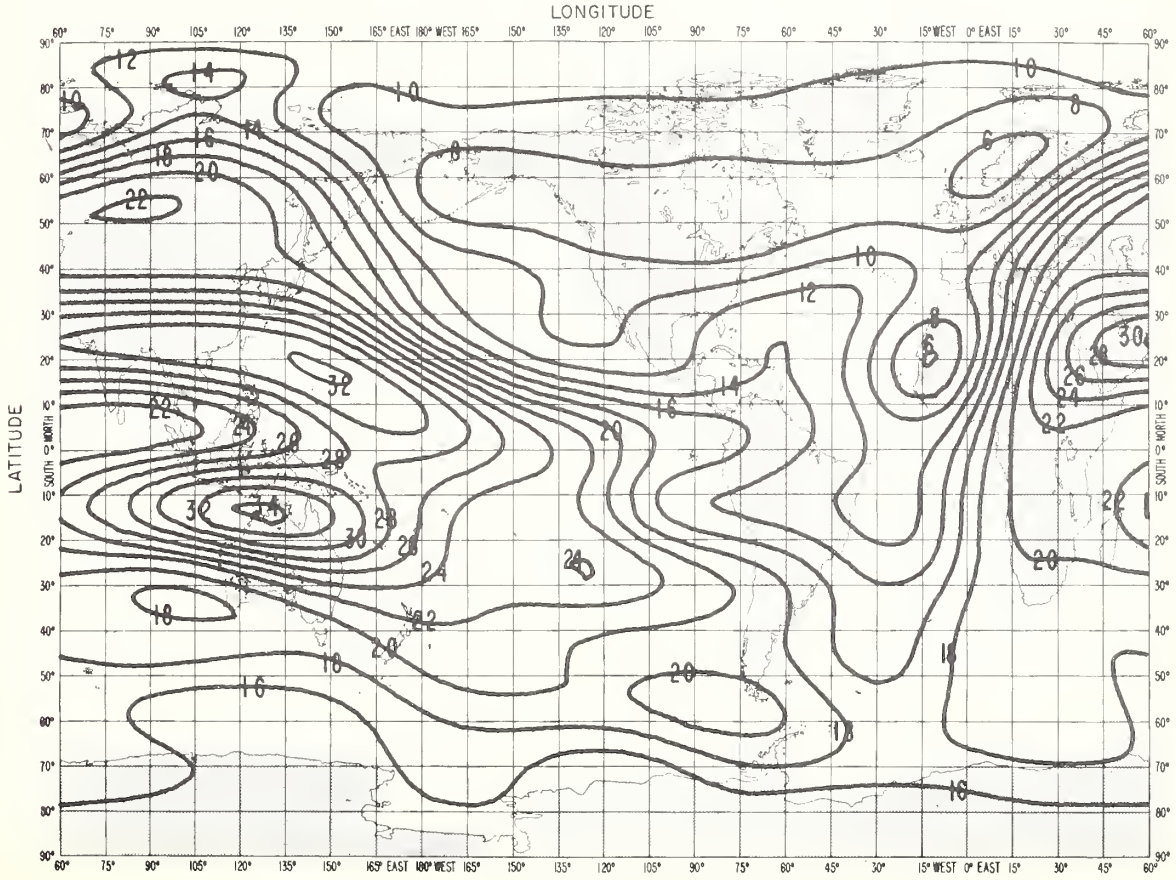

FIG. 4B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

DECEMBER 1964 UT=08

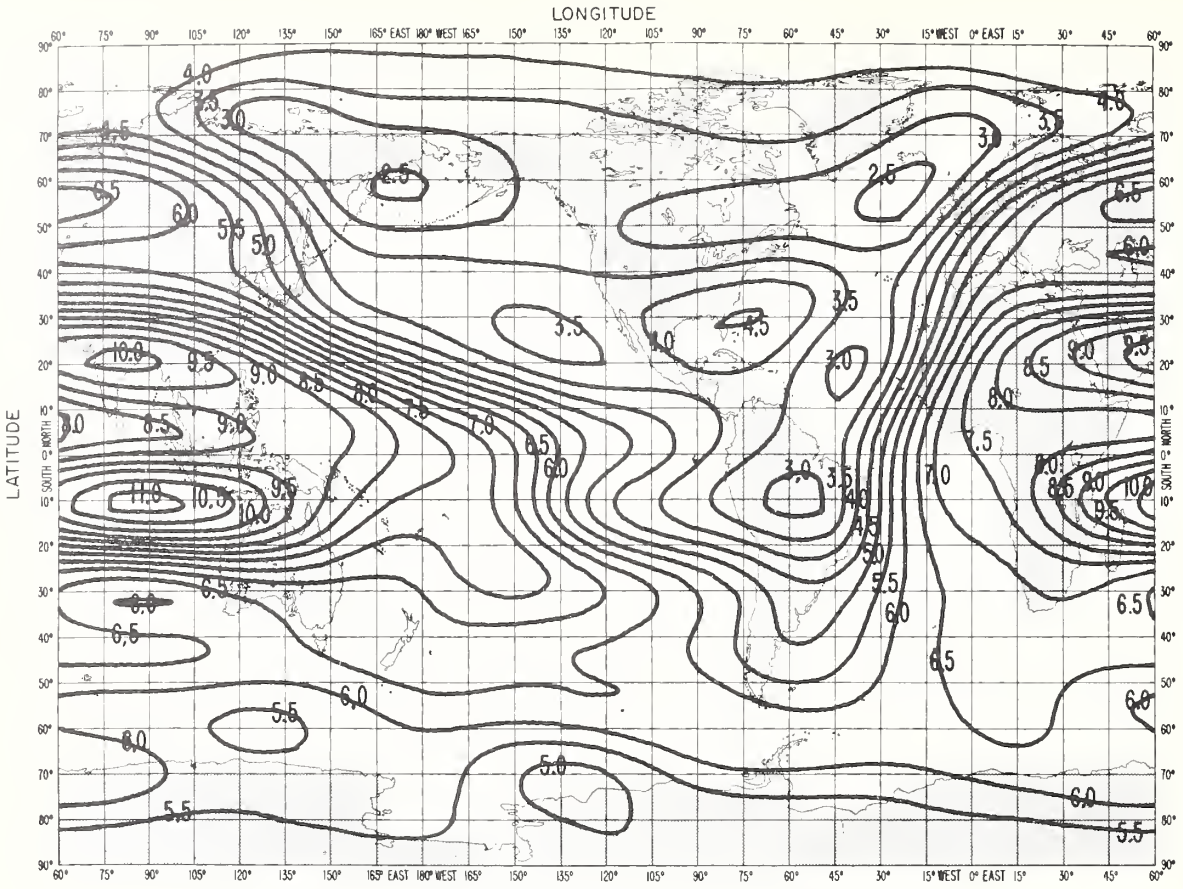

FIG. 5A. PREDICTED MEDIAN MUF (ZERO)F2 (Mc/s)

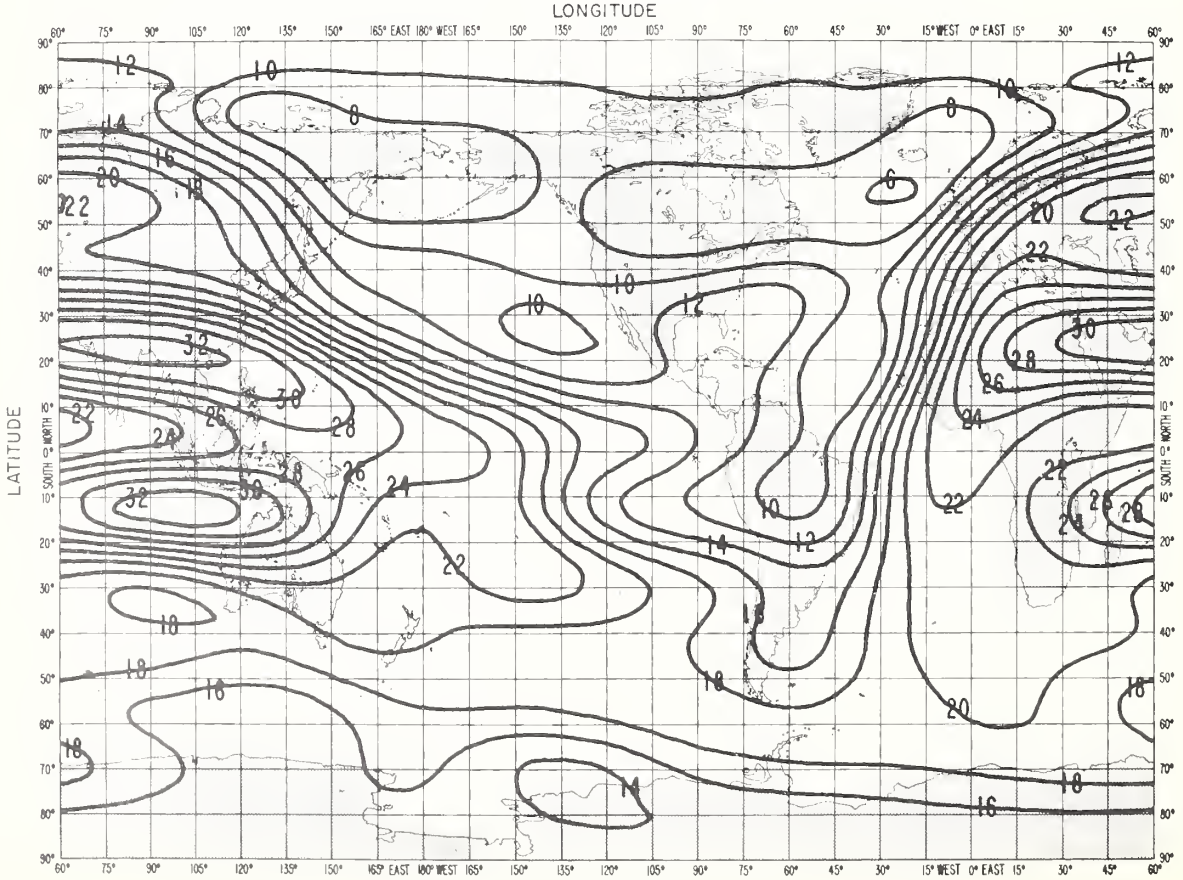

FIG. 5B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

DECEMBER 1964 UT = 10

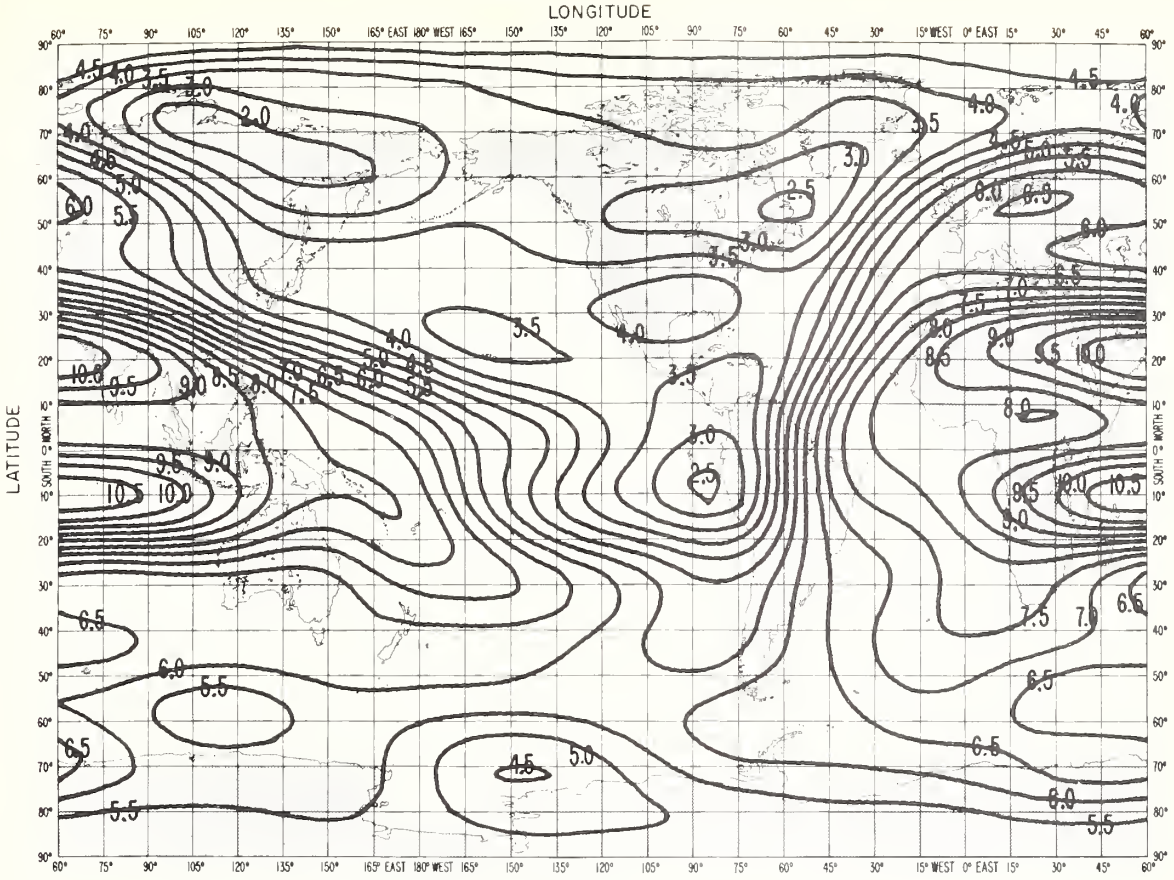

FIG. 6A. PREDICTED MEDIAN MUF (ZERO)F2 (Mc/s)

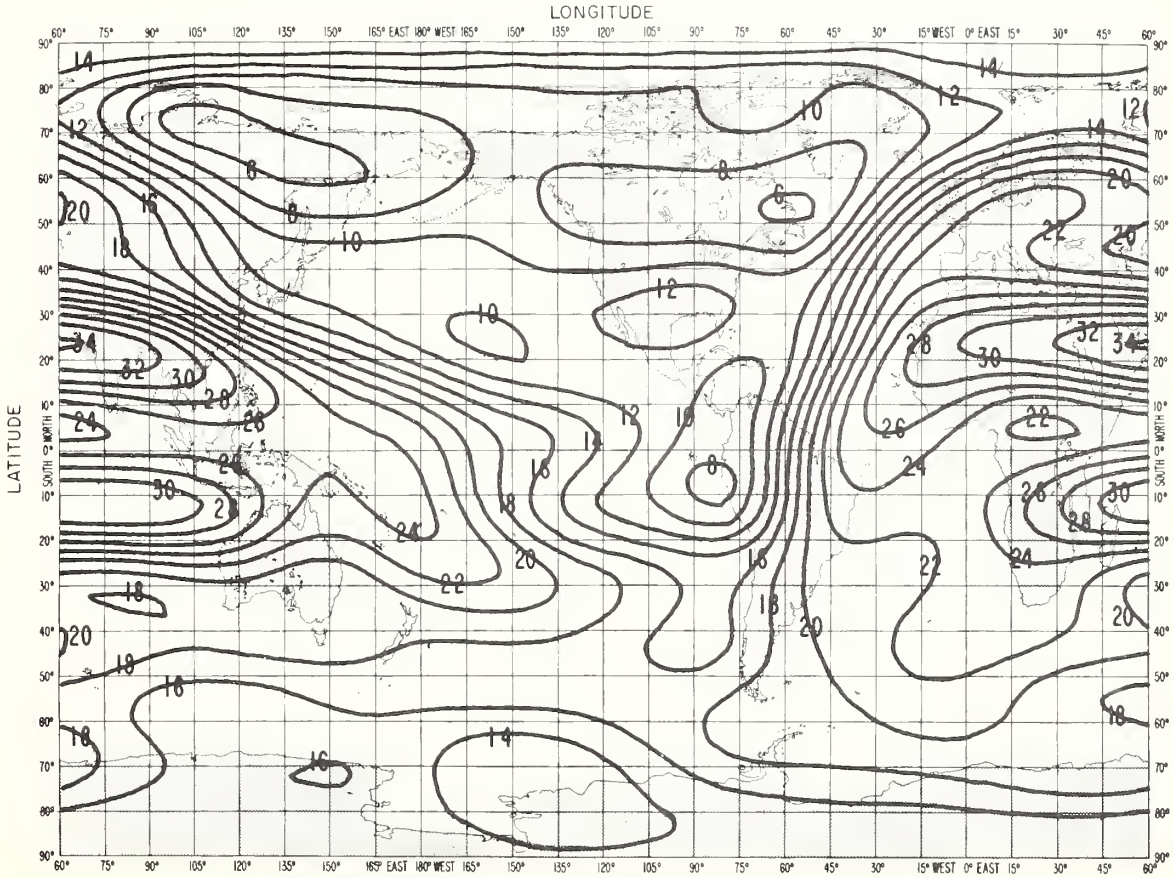

FIG. 6B. PREDICTED MEDIAN MUF (4000)F 2 (Mc/s)

DECEMBER 1964 UT=12

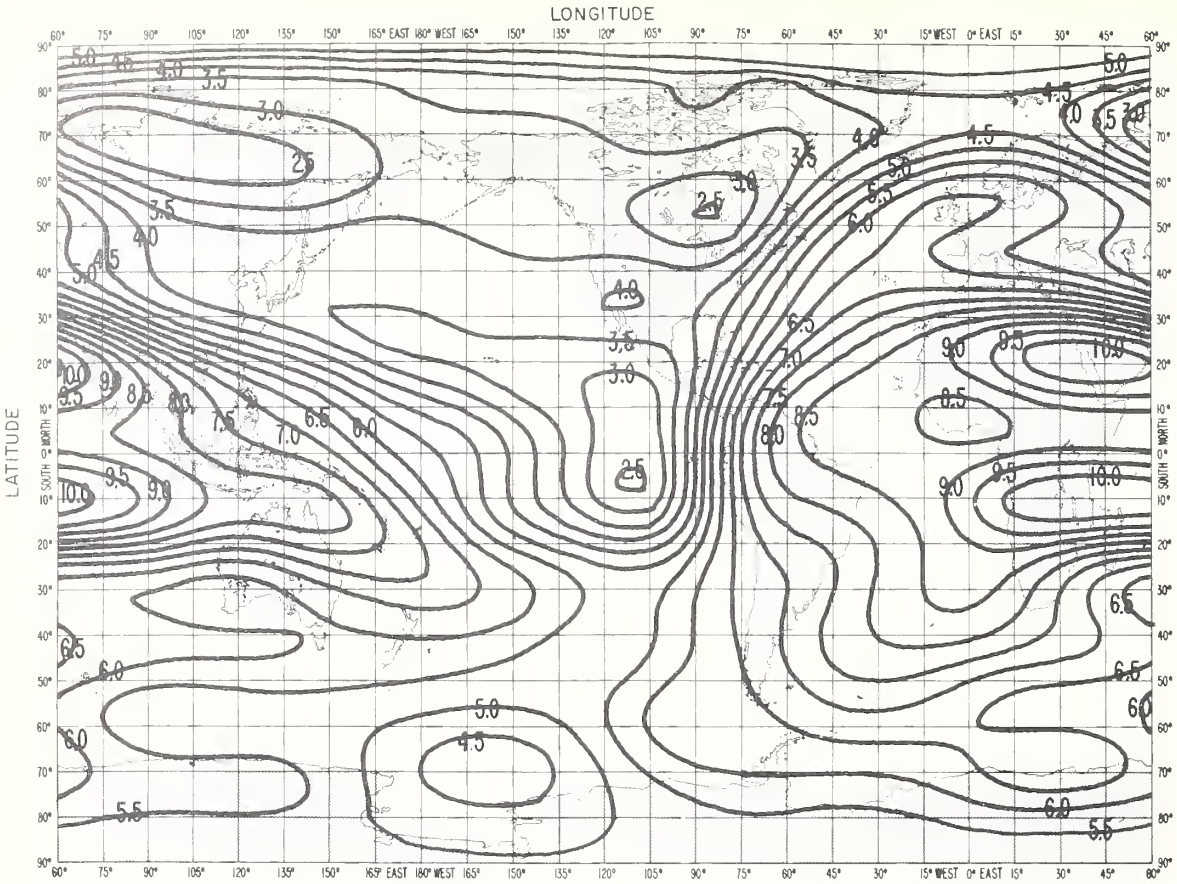

FIG. 7A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

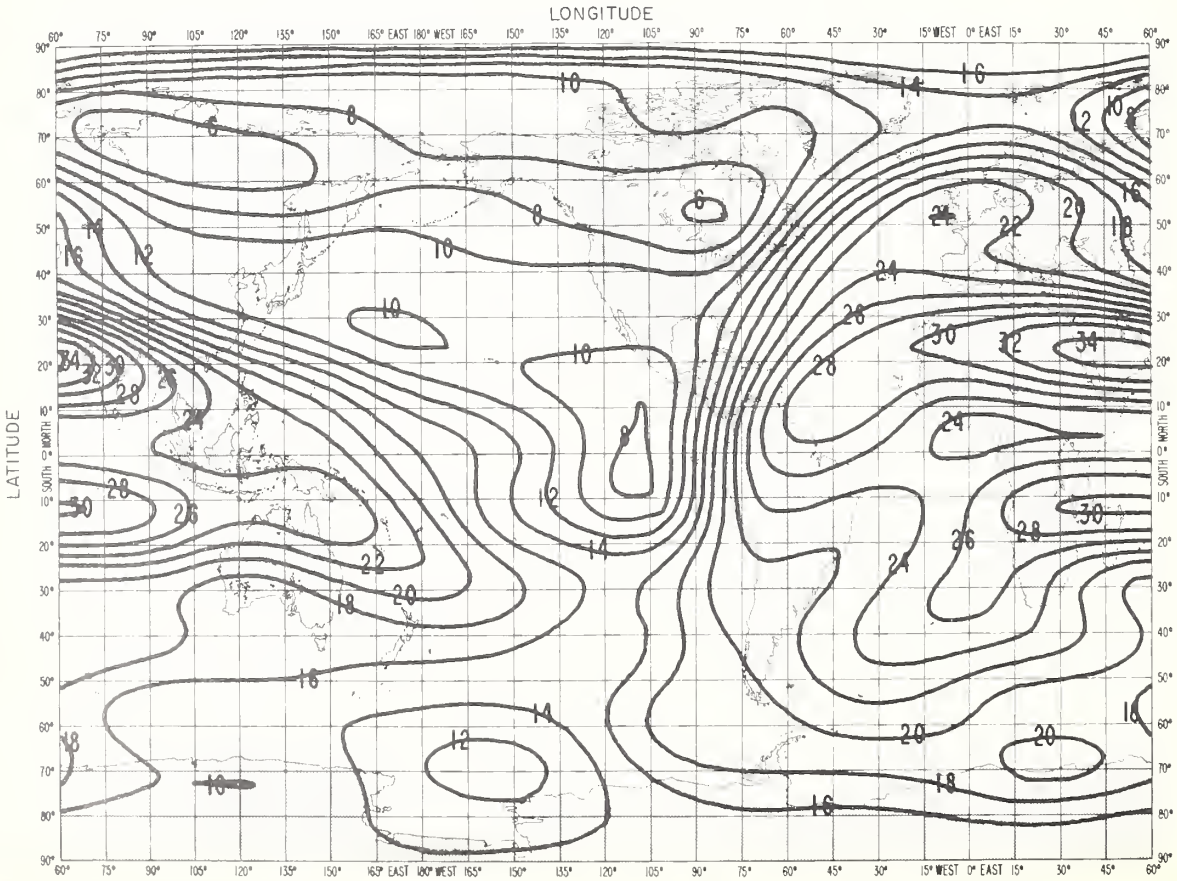

FIG. 7B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

DECEMBER 1964 UT=14

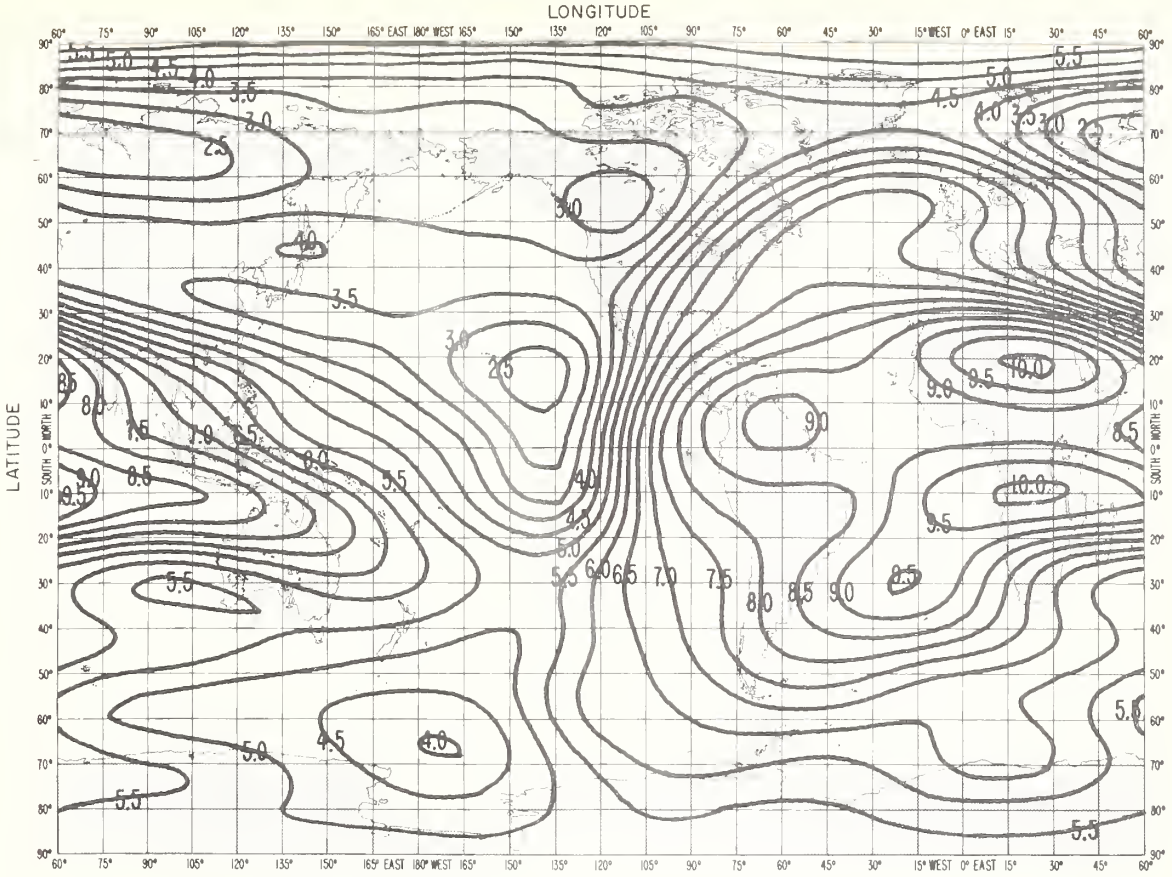

FIG. 8A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

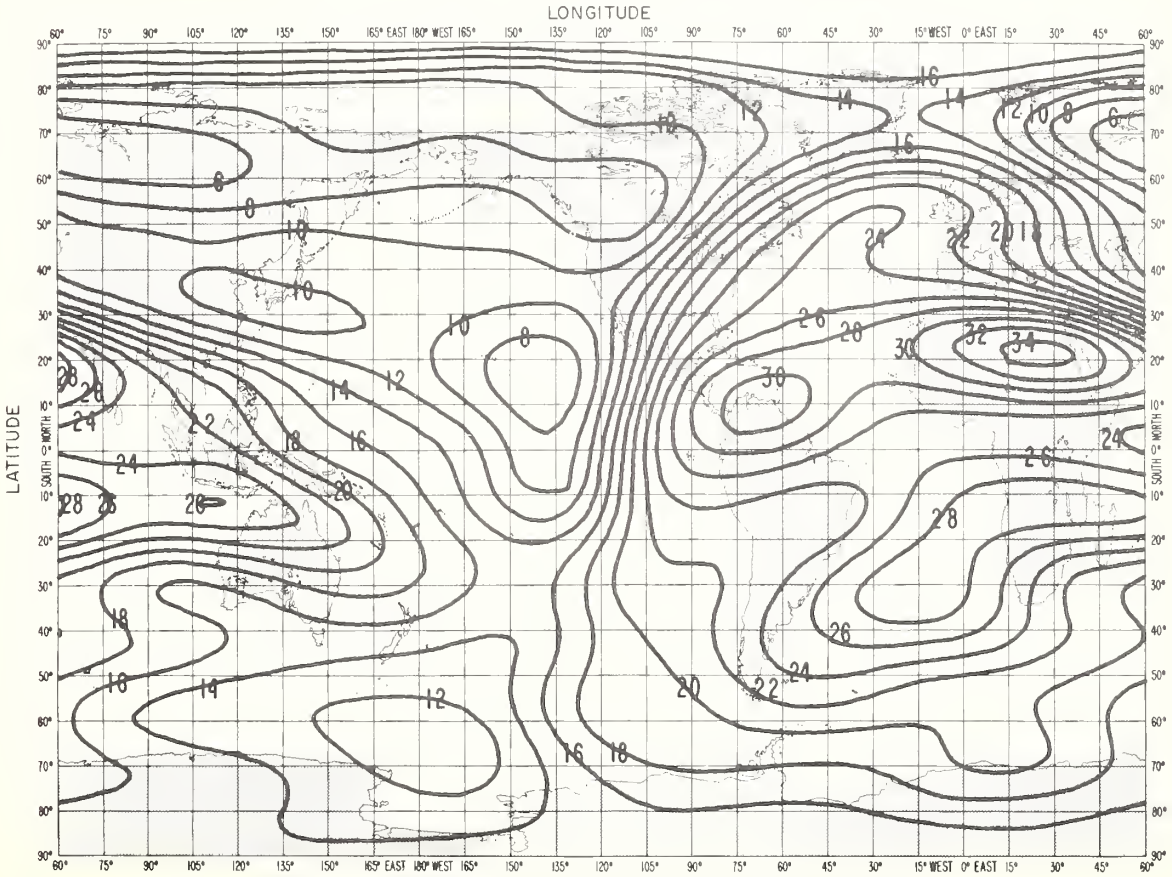

FIG 8B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

DECEMBER 1964 UT= 16

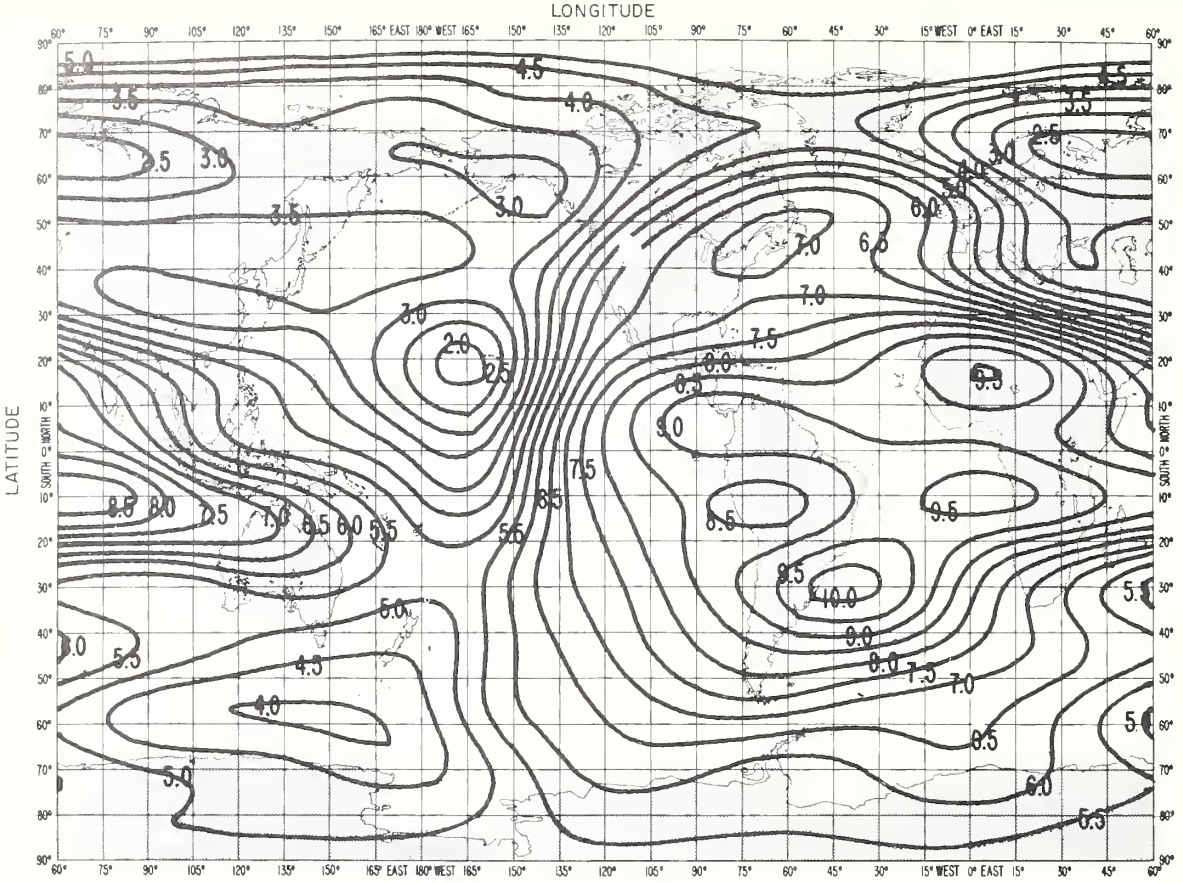

FIG. 9A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

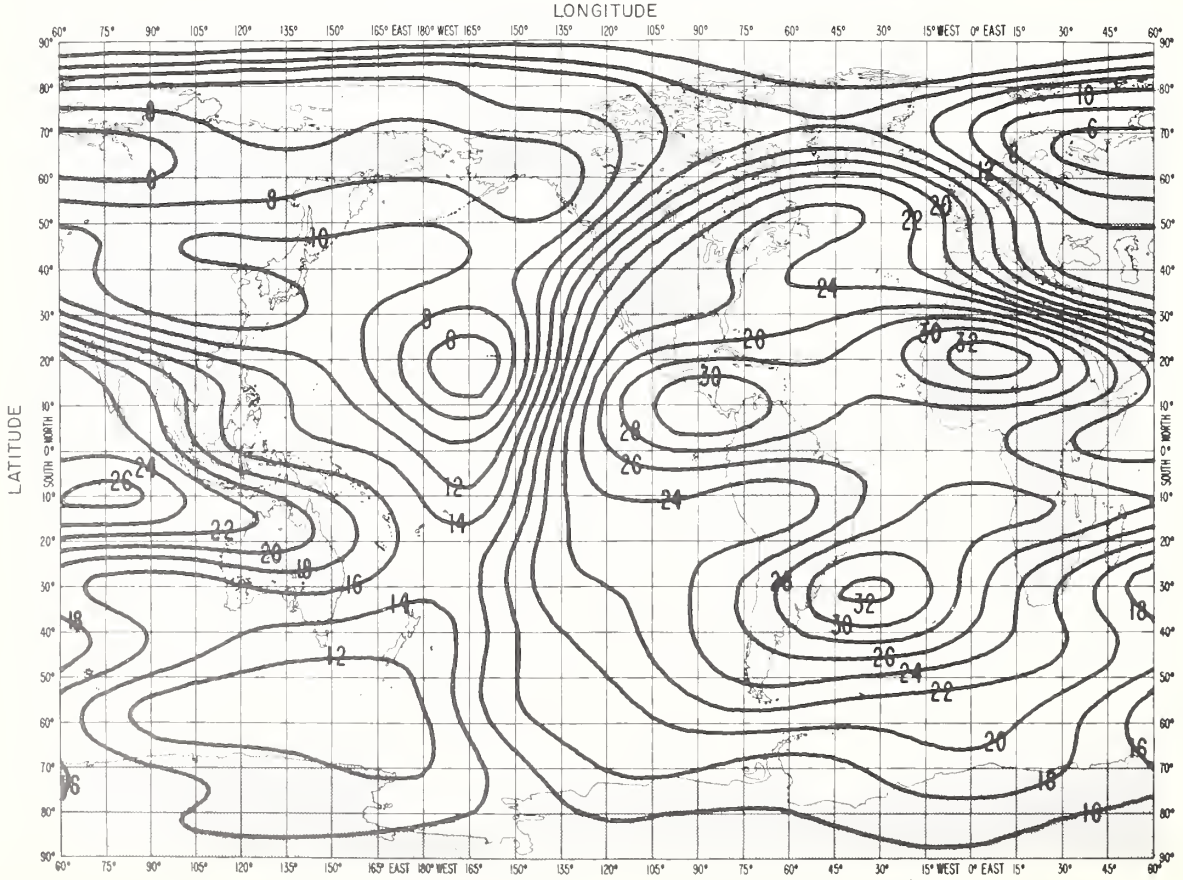

FIG. 9B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

DECEMBER 1964 UT= 18

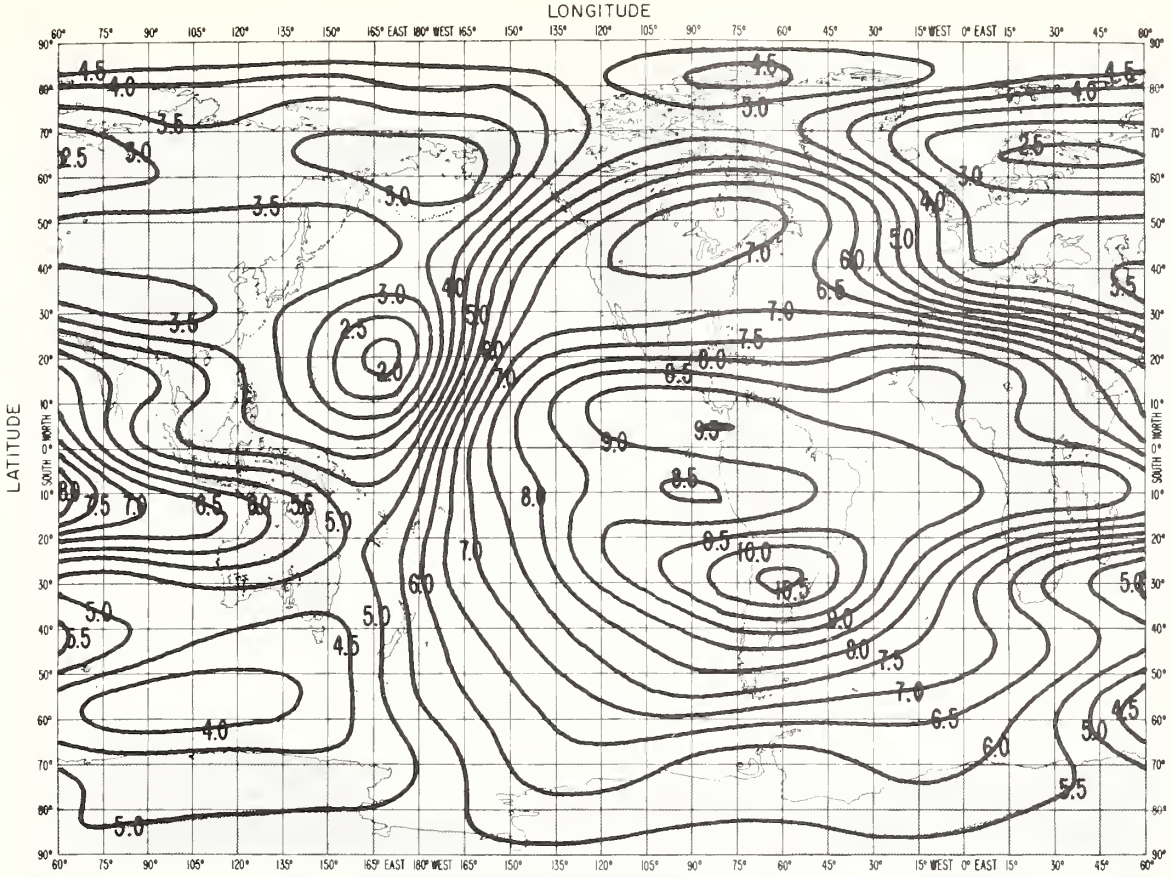

FIG. 10A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

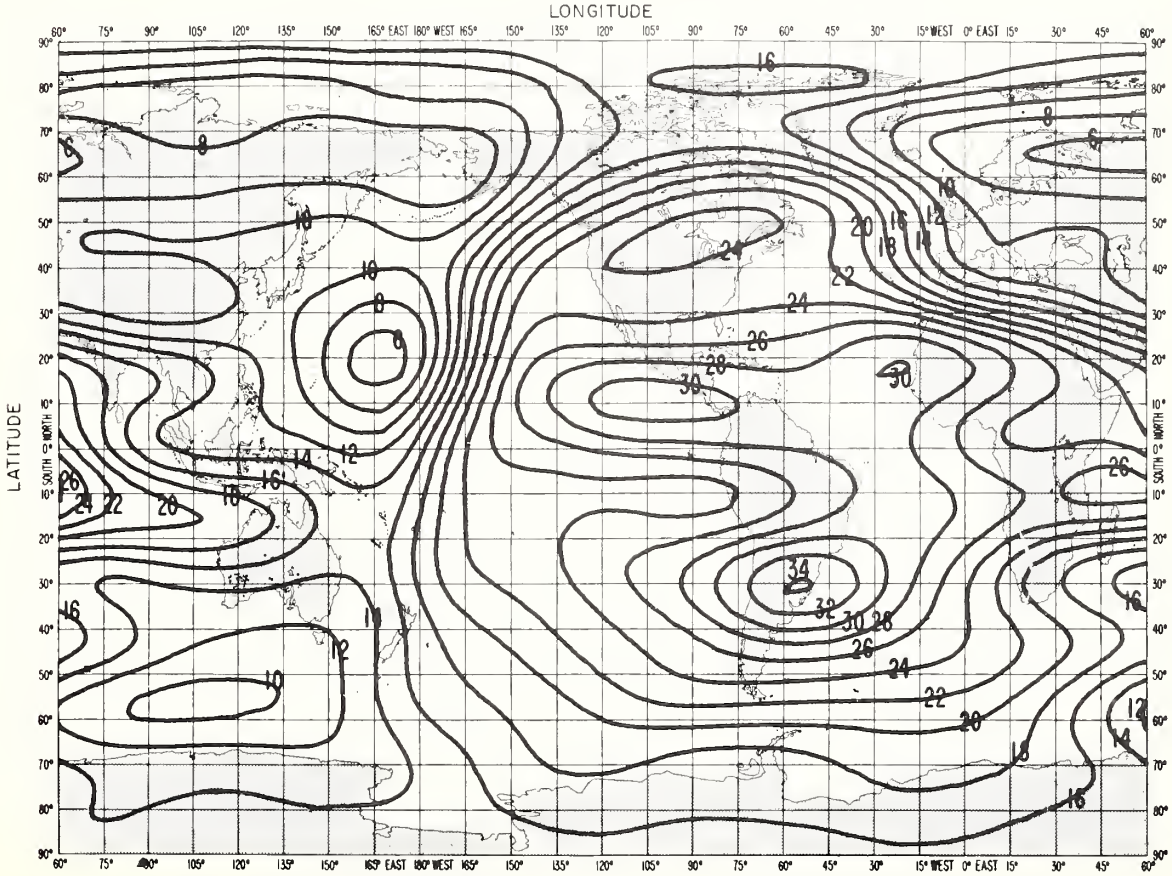

FIG. 10B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

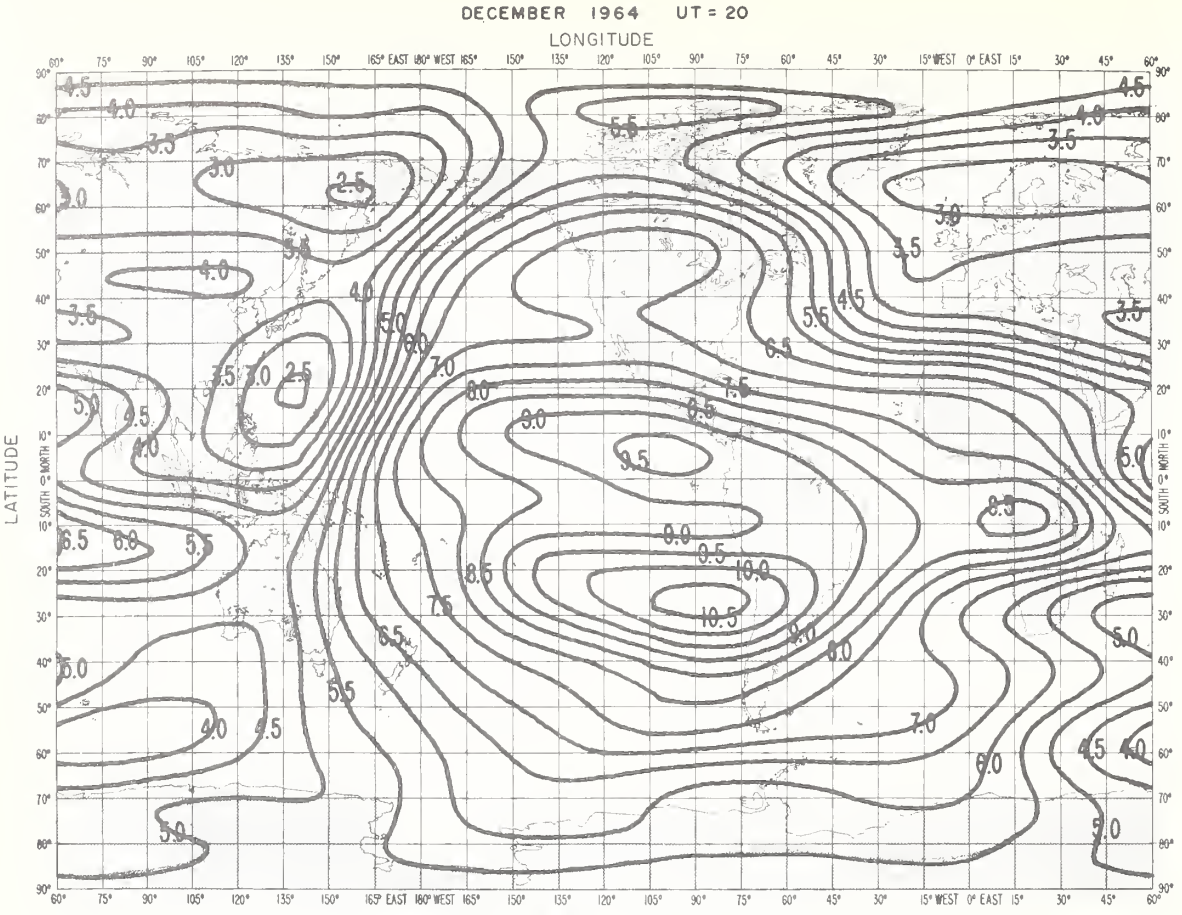

FIG. IIA. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

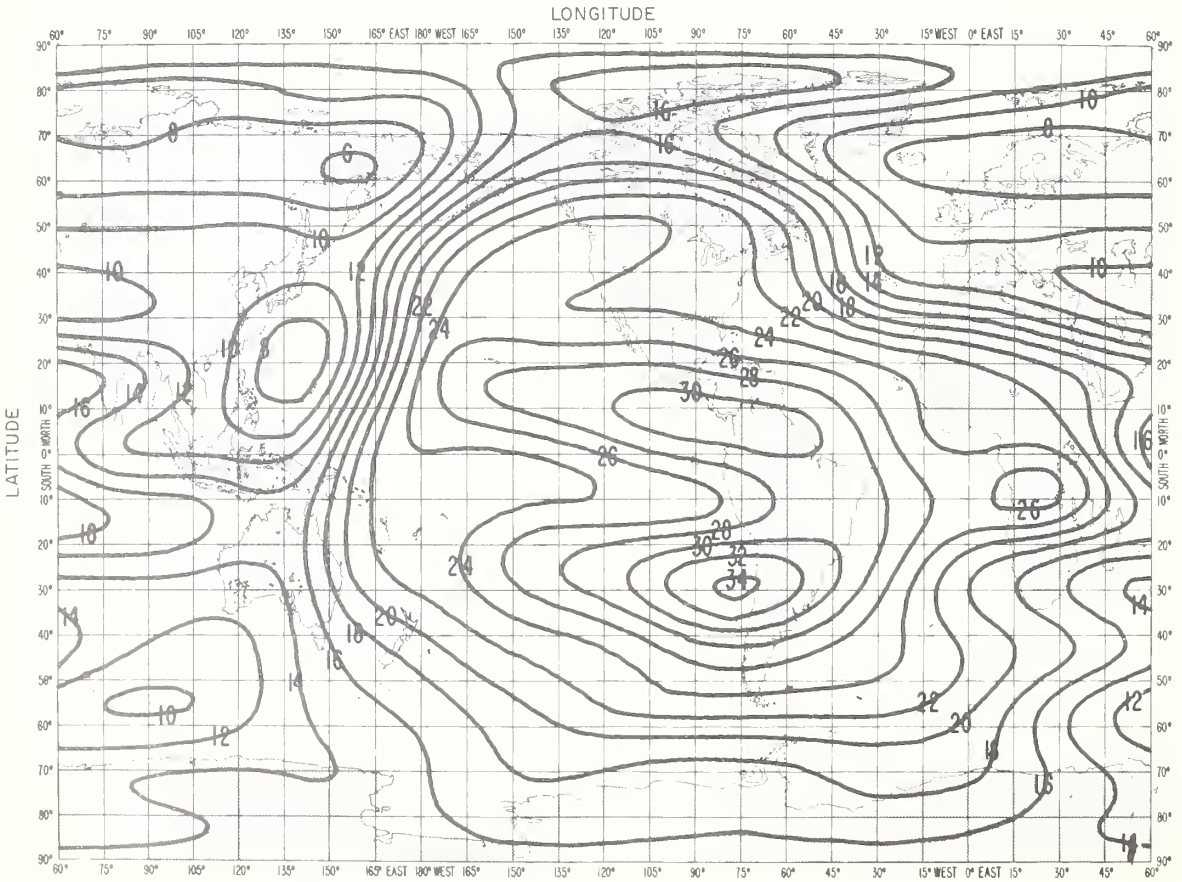

FIG. IIB. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

DECEMBER 1964 UT= 22

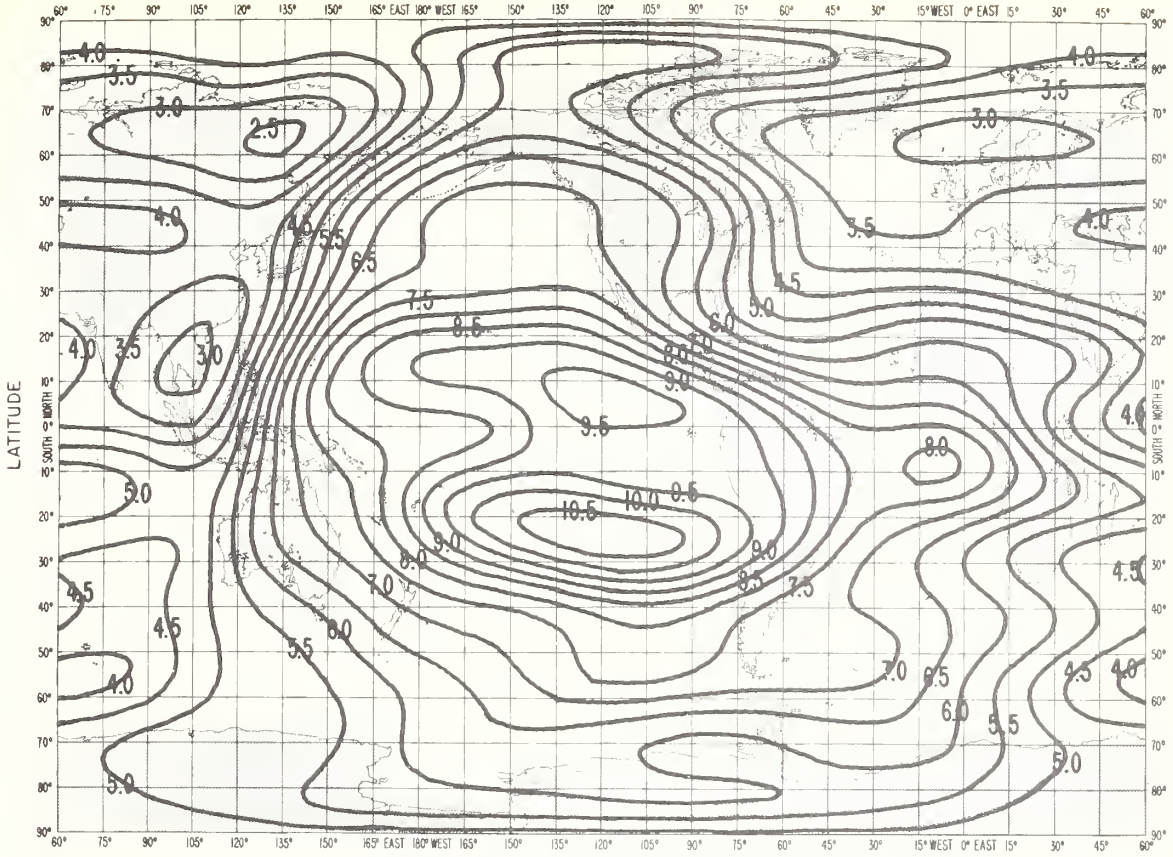

FIG. 12A. PREDICTED MEDIAN MUF(ZERO) F2 (Mc/s)

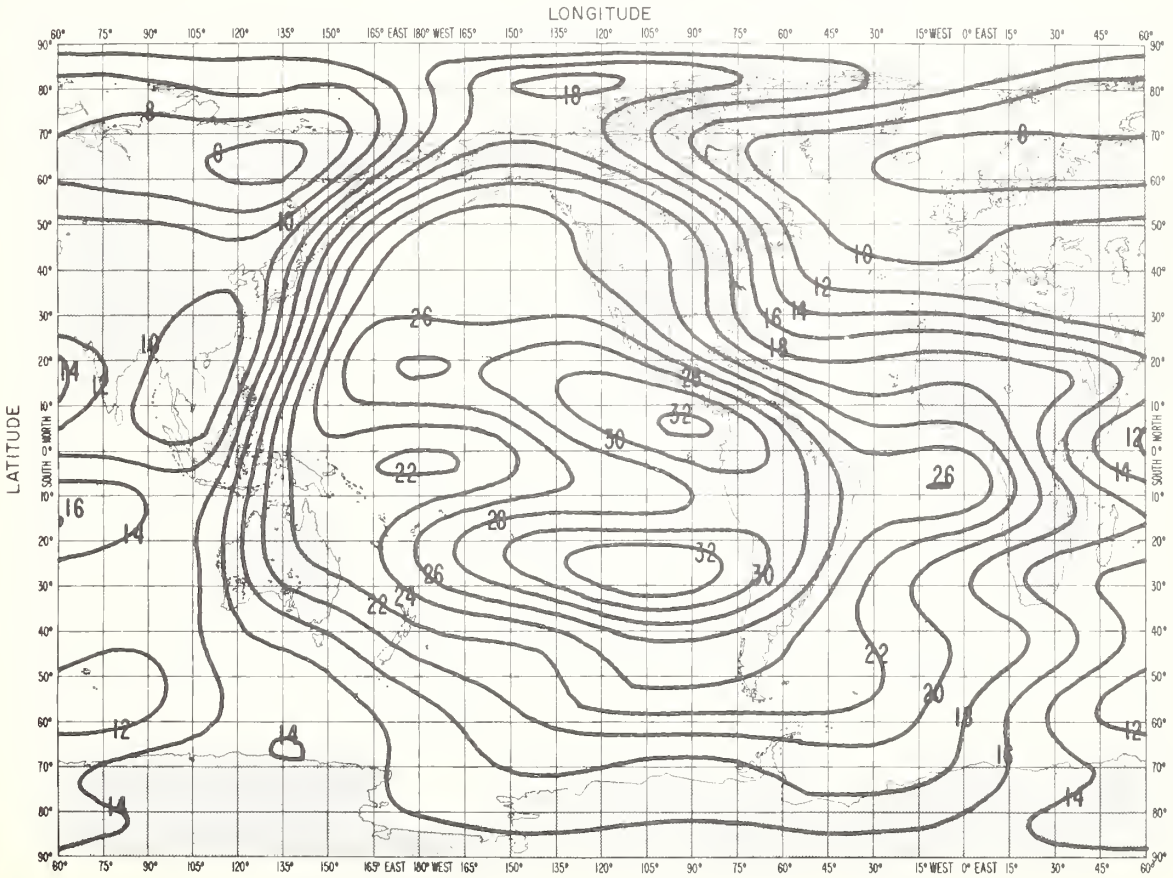

FIG. 12B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

NORTH POLAR AREA
DECEMBER 1964 UT = 00

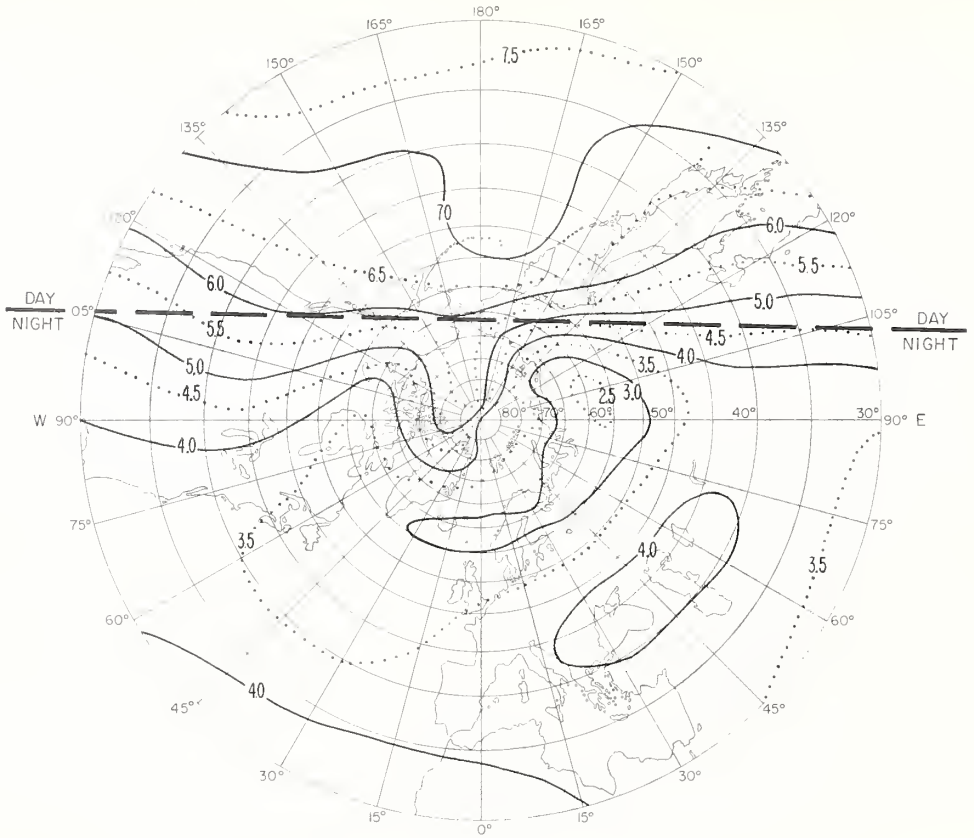

FIG. 13A. PREDICTED MEDIAN MUF (ZERO)F2 (Mc/s)

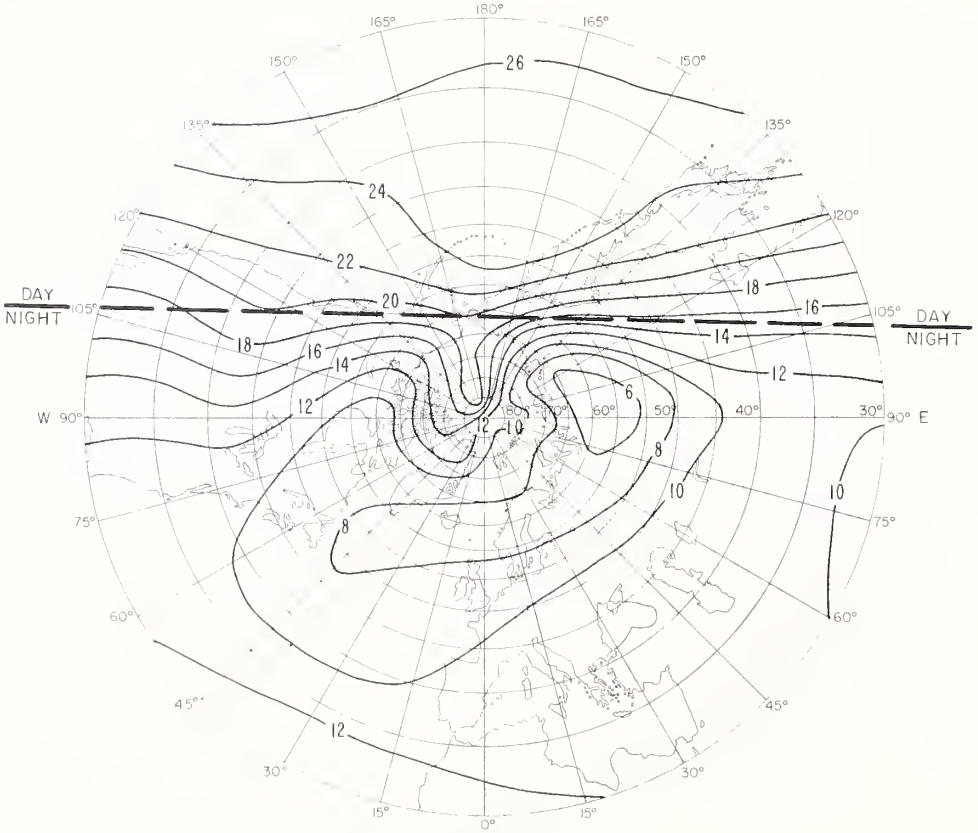

FIG. 13B. PREDICTED MEDIAN MUF (4000)F2 (Mc/s)

SOUTH POLAR AREA
DECEMBER 1964 UT = 00

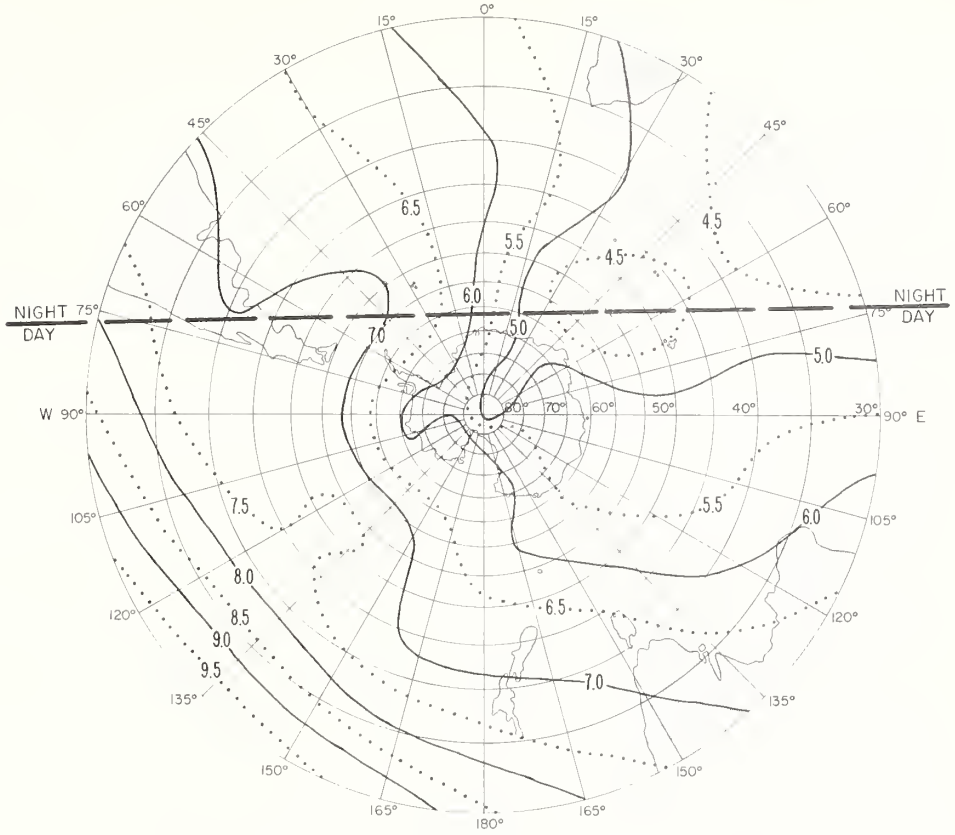

FIG. 14A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

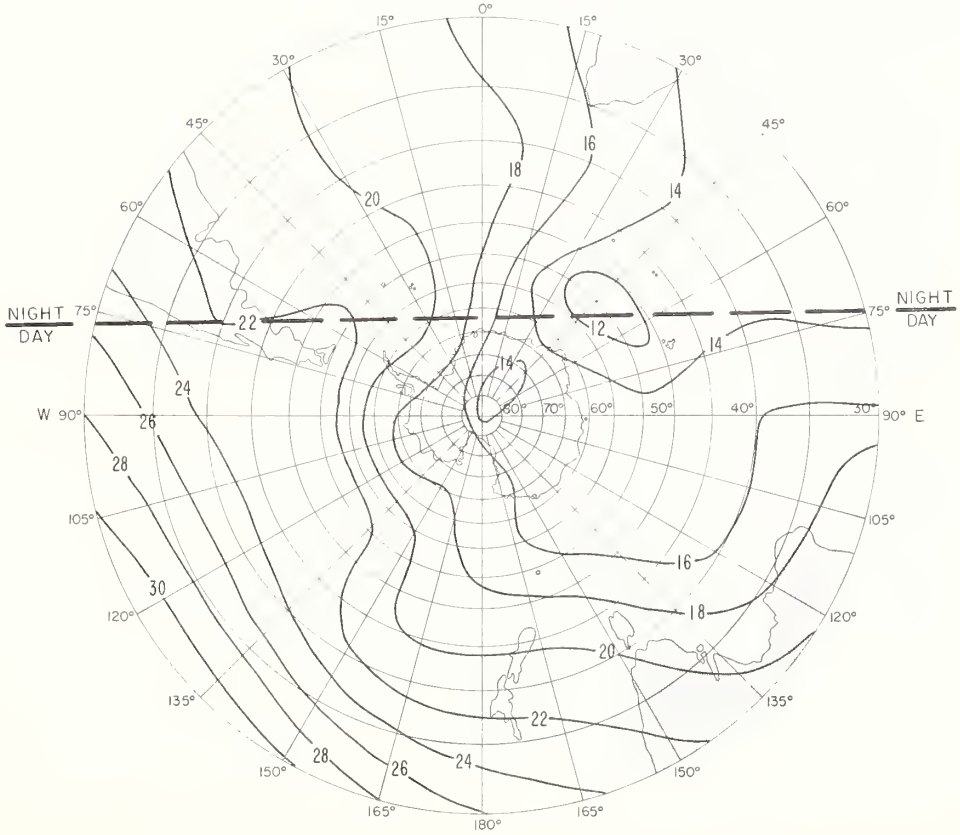

FIG. 14B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

NORTH POLAR AREA
DECEMBER 1964 UT = 12

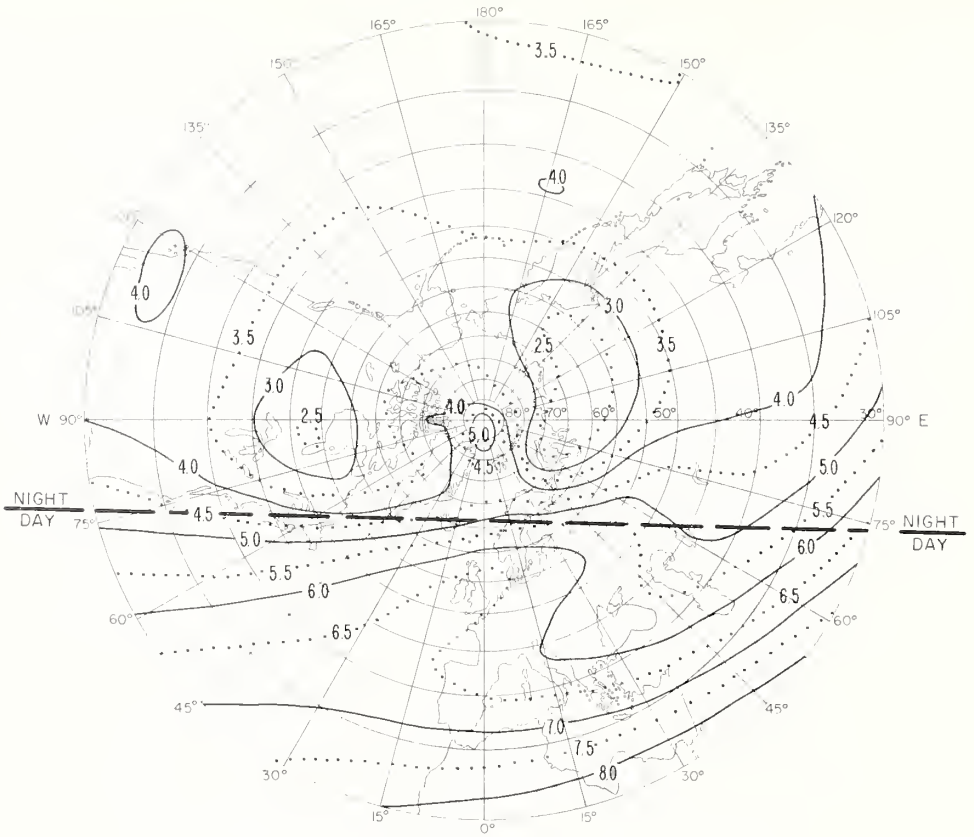

FIG. 15A. PREDICTED MEDIAN MUF (ZERO)F2 (Mc/s)

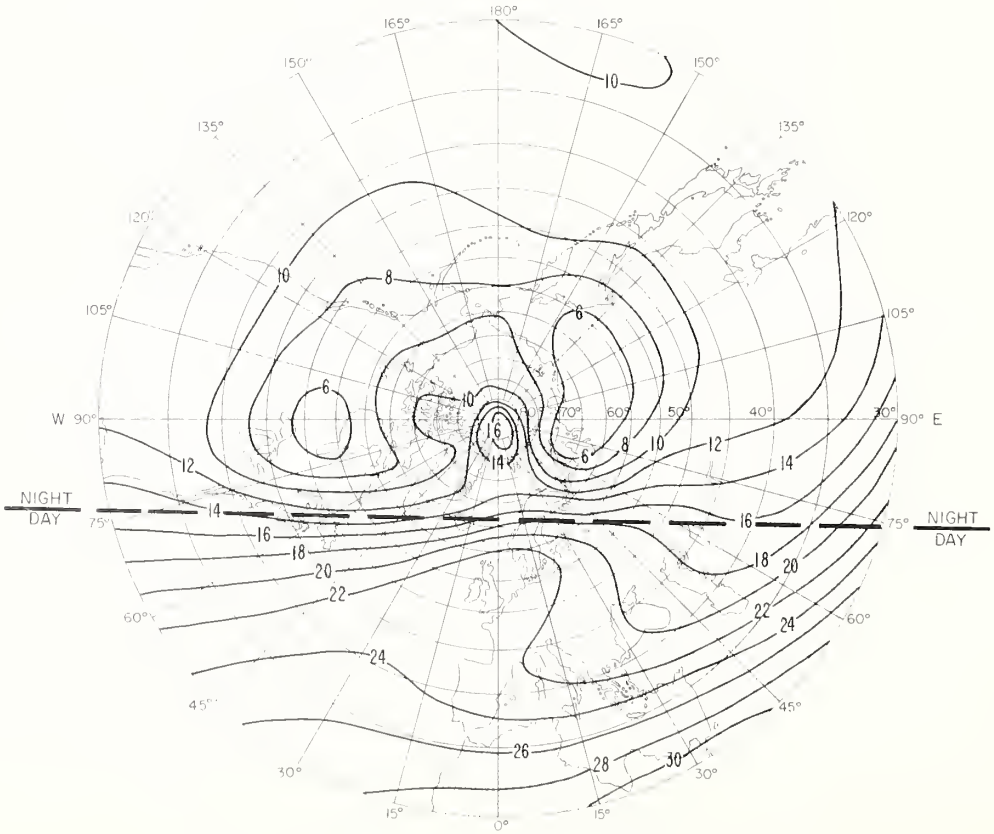

FIG. 15B. PREDICTED MEDIAN MUF (4000)F2 (Mc/s)

SOUTH POLAR AREA
DECEMBER 1964 UT = 12

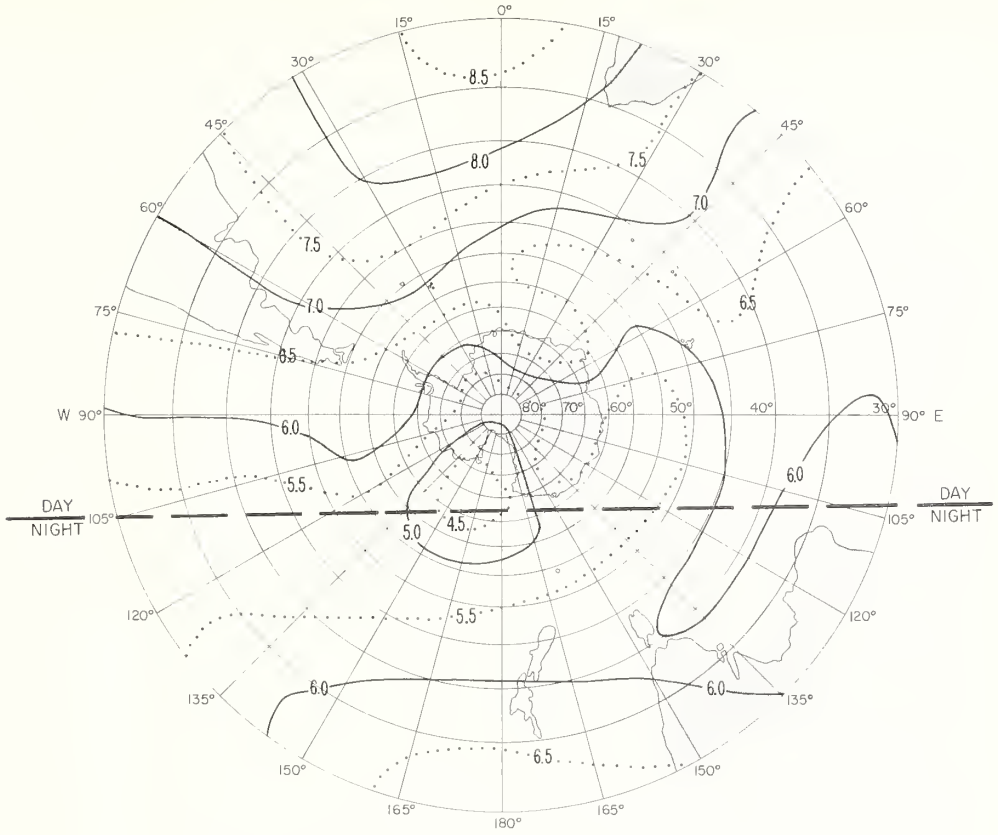

FIG. 16A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

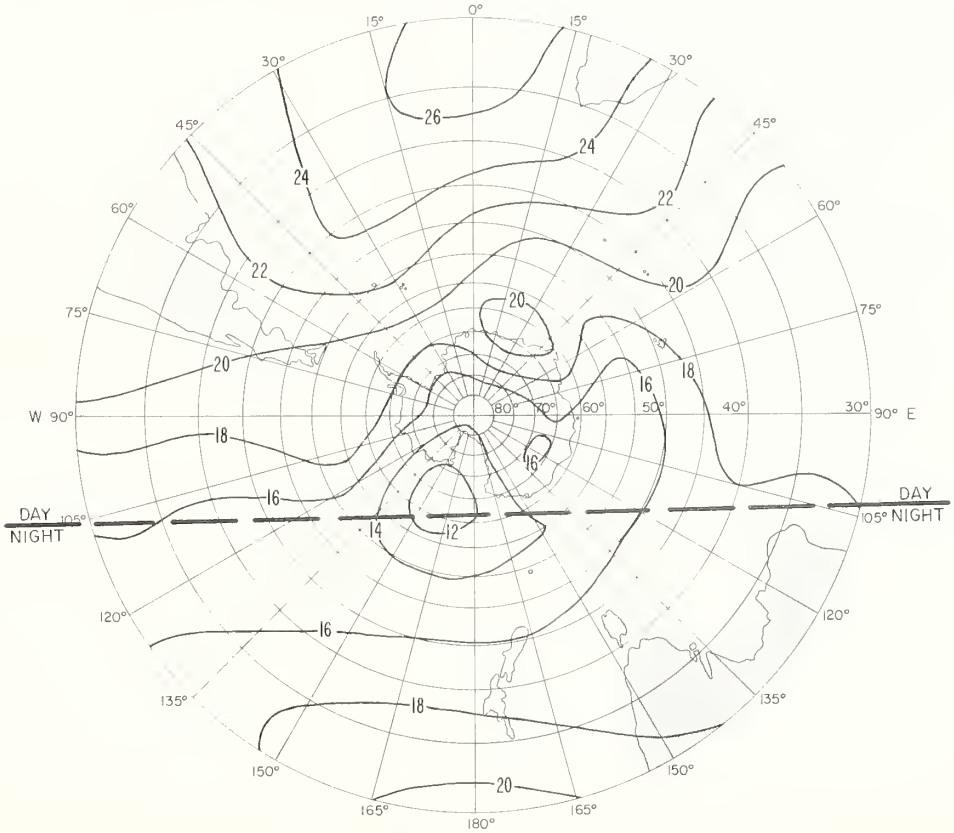

FIG. 16B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

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WASHINGTON, D. C., 20301, *1 September 1964*

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For explanation of abbreviations used, see AR 320-50.